2013 Survey Assessments and Analysis of Fish, Macroinvertebrates and Herpetofauna in the Otter Creek Coal Tracts Area of Powder River County

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Executive Summary

We summarize the third year of baseline surveys for aquatic communities and herpetofauna in the Otter Creek coal tracts area. Project goals remain the same: 1) to continue standardized surveys and collecting baseline information on the aquatic communities prior to coal development, 2) to seasonally assess aquatic community integrity and condition with key indicators recorded on-site and comparing these against biotic thresholds of reference condition standards and testing treatment differences. These 2013 aquatic community data represent the third year of pre-coal development (i.e. pre-impact BACI, Before After Control Impact design) conditions at the local reach scale.

Habitat assessments, herpetofauna, macroinvertebrate and fish surveys were performed during seasonally similar dates at the same sites visited in 2011 and 2012: four main-stem Otter Creek reaches (Control, Impact {2} and Downstream) and three tributary streams. In total, we performed 15 fish surveys during 2013. Thirteen macroinvertebrate samples were collected during the visits; neither survey was conducted at Threemile Creek during any season due to lack of surface water present. All stream reaches were visually and aurally surveyed for amphibians and reptiles during all visits. Biological community integrity was calculated for 15 fish surveys using Fish Integrated Biotic Indices (IBI's) and Observed/Expected Models (O/E), while the 13 macroinvertebrate samples were assessed with Montana DEQ's multi-metric indices (MT MMI).

Habitat Evaluations. Of the seven reaches evaluated in the study area, we found three in Proper Functioning Condition (PFC) with a stable trend; three were Functional at Risk (FAR) and one non-functional (NF). Sites ranked FAR or NF due to stream habitat structurally degraded by cattle (Home {Otter_1A}, Tenmile {Otter_23} and Threemile {Otter_3m} Creeks) or stream manipulation (Otter Creek #2). Highest site integrity scores using both the BLM Habitat and PFC Assessment methods were recorded at Otter Creek sites #22 and JT, Denson Control and Trusler reaches, respectively. Sites with lower habitat scores are inversely correlated with high livestock use indices (CPI values). Specific Conductivity measurements recorded at all Otter Creek mainstem sites across all seasons were above the impairment threshold levels (>500µs, MDEQ 2006b).

Macroinvertebrate Communities: Overall, 78 unique macroinvertebrate taxa were reported in 2013 from 13 macroinvertebrate assessment samples. One mayfly species of concern (MTSOC), *Caenis youngi* was collected at the Otter Creek sites #16 and #22. Highest taxa richness (37 spp.) was reported at Otter JT during the fall visit, while overall macroinvertebrate richness per site was 29.1 taxa, slightly less than 2012 or 2011. Using the MTDEQ multimetric index (MMI), four of the five sites (11 of 13 samples) were ranked non-impaired (good biological integrity), while two samples from Tenmile (Otter_23) and Home Creek (Otter_1A) were ranked impaired. MMI scores in 2013 were not significantly different than 2012 scores ($p > 0.4$). Sites that maintained flowing water connectivity scored higher with the MMI than sites with interrupted pool areas. Overall, mainstem sites evaluated in the Otter Creek study had significantly different MMI scores than those in the tributaries (ANOVA, $p < 0.01$). MMIs did not significantly differ between Otter Creek mainstem Pre-Impact Control, Impact or Downstream Sites (T-test, $p > 0.05$), despite fish communities reflecting a downstream decrease in biotic integrity.

Fish Communities. Overall, ten fish species (five native/five introduced) were identified from 16,215 individuals collected during 15 surveys. The brassy minnow, a potential species of concern (PSOC),

was collected at five sites during all 15 surveys. Average total fish species per Otter Creek mainstem site across all seasons was 6.7 (± 0.5 SE), a slight decrease from 2012 (7.0). Brassy minnows had the highest site occupancy rate of 100% (15 of 15 visits) followed by lake chubs, fathead minnows, and white suckers at 80% and 67% (12 and 10 out of 15 visits), respectively. Lake chubs edged out fathead minnows in 2013 to account for the highest proportion of total individuals collected at 28%. The most diverse fish site in the study area was Otter Creek #16 with nine species, while sites with the highest % of native species were Otter Creek JT (five spp.) and Home Creek (two native spp.). Using Montana's Prairie Fish Integrity Biotic Index (IBI), nine of the 15 fish visits ranked non-impaired (good integrity), five were slightly-moderately impaired and one was ranked poor. As seen in 2012, fish IBI's decreased going downstream in the Otter Creek mainstem and seasonally with lowest scores recorded during the fall. In 2013, fish IBI scores of the Control Site were not significantly different than either the Impact (p= 0.089) or the Downstream site (p=0.24) using Student T-tests, but the O/E scores of the Control were significantly different than Impact sites (p=0.02) and the Downstream site (p=0.04). The O/E scores agreed with the IBI in most cases, except Otter_2 summer, where the O/E showed non-impairment (0.91), but the IBI score (54) indicated impaired fish integrity. Further evaluations into the relationship of the O/E to the IBI are needed for non-natives. A fish anomaly index recorded the highest scores at the Impact sites, especially increasing at Otter #2 in 2013

Amphibian and Reptile Incidentals. Nine herpetofauna species were observed or collected in conjunction with the assessment surveys. Of the four amphibian species; the Northern Leopard Frog (*Lithobates pipiens*) had the highest site occupancy, occurring at four of seven sites, followed by the Woodhouse's Toad (*Anaxyurus woodhousii*) and Boreal Chorus Frog (*Pseudacris maculata*) both recorded at three sites. The Boreal Chorus Frog was detected vocally calling at two sites during the spring visits. Tiger salamanders (*Ambystoma tigrinum*) continue to use Home Creek (Otter_1A) as a breeding area, as evidenced by larvae captured while seining during summer visits. We also recorded five reptile species (in order of site occurrence): Painted Turtle (*Chrysemys picta*), Snapping Turtle (*Chelydra serpentina*) (a MTSOC), Western Rattlesnake (*Crotalus viridis*), Gopher snake (*Pituophis catenifer*) and Terrestrial Garter Snake (*Thamnophis elegans*).

Conclusions. Otter Creek mainstem reaches within the area proposed for the future mine site (i.e. Impact Zone sites) continue to show higher impairment levels in biological integrity than the Control or Downstream reaches. Spatial and temporal patterns of aquatic community composition and biotic integrity were similar between the 2013 and 2012 surveys, with a notable increase in the percentage of non-native fish occurring across most sites, especially in the fall. Biotic integrity of the Otter Creek upstream control reach remains higher than impact or downstream reaches (based on fish), but has decreased since 2011. Macroinvertebrates show no discernible pattern of integrity spatially, but temporally are reporting higher integrity scores during the spring samples. Fish communities have reassembled themselves since the high water of 2011 with the addition of the golden shiner to three sites in 2012, but they were only reported at one site in 2013. The high density and biomass of fish captured below Truslers Ranch road crossing, 20,000 fish per 300 m in fall 2011, has dispersed to other sections and now averages 1,900 fish per 300 m, but still has a high percentage of fish anomalies (lesions and parasites- yellow grub and anchorworm). Fish anomaly scores are significantly higher at the Impact Zone sites than reported at the other reaches.

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All photos in the report were taken by MTNHP personnel, unless otherwise noted

Introduction

The Otter Creek basin southeast of Ashland, Montana is currently undergoing exploration for a large, open-pit coal mine. Baseline data on the condition of the watershed prior to coal mine development (pre-impact) is essential to determine what effects the coal extraction might have on the fish and wildlife in, and downstream of, the effected extraction area (post-impact). Initial evaluations of the aquatic communities determined that no Federally Listed species under the Endangered Species Act would be affected in the coal tracts area (BLM 2002), but this Environmental Assessment did not take into account the presence of Montana Species of Concern (MTSOC) or other ecologically sensitive native species assemblages. Despite numerous projects undertaken to document and monitor biological communities in CBNG areas of the Powder and Tongue River watersheds (Confluence Consulting Inc. 2004; Stagliano 2006; Davis et al. 2009; Maxell 2009; Petersen et al. 2009, 2010; Farag et al. 2010; Stagliano 2011), large gaps still exist in basic baseline surveys for macroinvertebrates, fish, and herpetofauna in the Otter Creek basin. Fish communities have been documented to be seasonally variable in prairie streams (Bramblett and Fausch 1991, Lohr and Fausch 1997, Matthews 1998), thus sampling across all seasons in multiple years is a good strategy to document baseline community differences. Over three years of stream monitoring, Otter Creek's annual discharge statistics reported a historically "wet" year in 2011 (14.6 cfs), a "normal" water year in 2012 (8.6 cfs), though this was still almost two times higher than the 35 year average (4.7 cfs), and a slightly more normal discharge year in 2013 (7.7 cfs) (USGS 2013). Highly variable seasonal discharge patterns are common for Otter Creek and other perennial prairie streams in Montana. Water availability in many small prairie streams that constitute the Intermittent Prairie Stream ecological system (Stagliano 2005) is highly variable, and these streams may have downstream connectivity early in the season for potential fish spawning and nursery areas (Matthews et al. 1988, Bramblett et al. 2005) or no fish colonization at all in dry years and become isolated pools important areas for amphibian breeding and rearing (Stagliano 2011). Identifying spatial and temporal baseline communities and conditions in streams of the coal tracts area (i.e., presence of fish, macroinvertebrate, and herpetofauna) prior to coal development is essential to understanding and potentially mitigating impacts to habitats and species during and after coal extraction.

Methods

Study Area

Pre-impact baseline sampling sites visited in 2013 were the same reaches designated in 2011 (Stagliano 2012). These sites are representative of the range of stream types found in the Otter Creek Coal Tracts project area: Ephemeral, Intermittent and Perennial Prairie Streams. Four mainstem Otter Creek reaches (control, impact {2} and downstream) and three tributaries

coinciding with established surface water quality stations were visited seasonally (May, July, October) (Table 1). Threemile Creek remained dry during all visits and no fish or macroinvertebrate surveys were conducted (see Site Photos). Seasonal site visits were timed with 2011 and 2012 dates, and we coordinated sampling with baseflow discharge levels, which was easily accomplished in the spring of 2013 compared to 2012, because there was largely no spring, high discharge pulse (Figure 1).

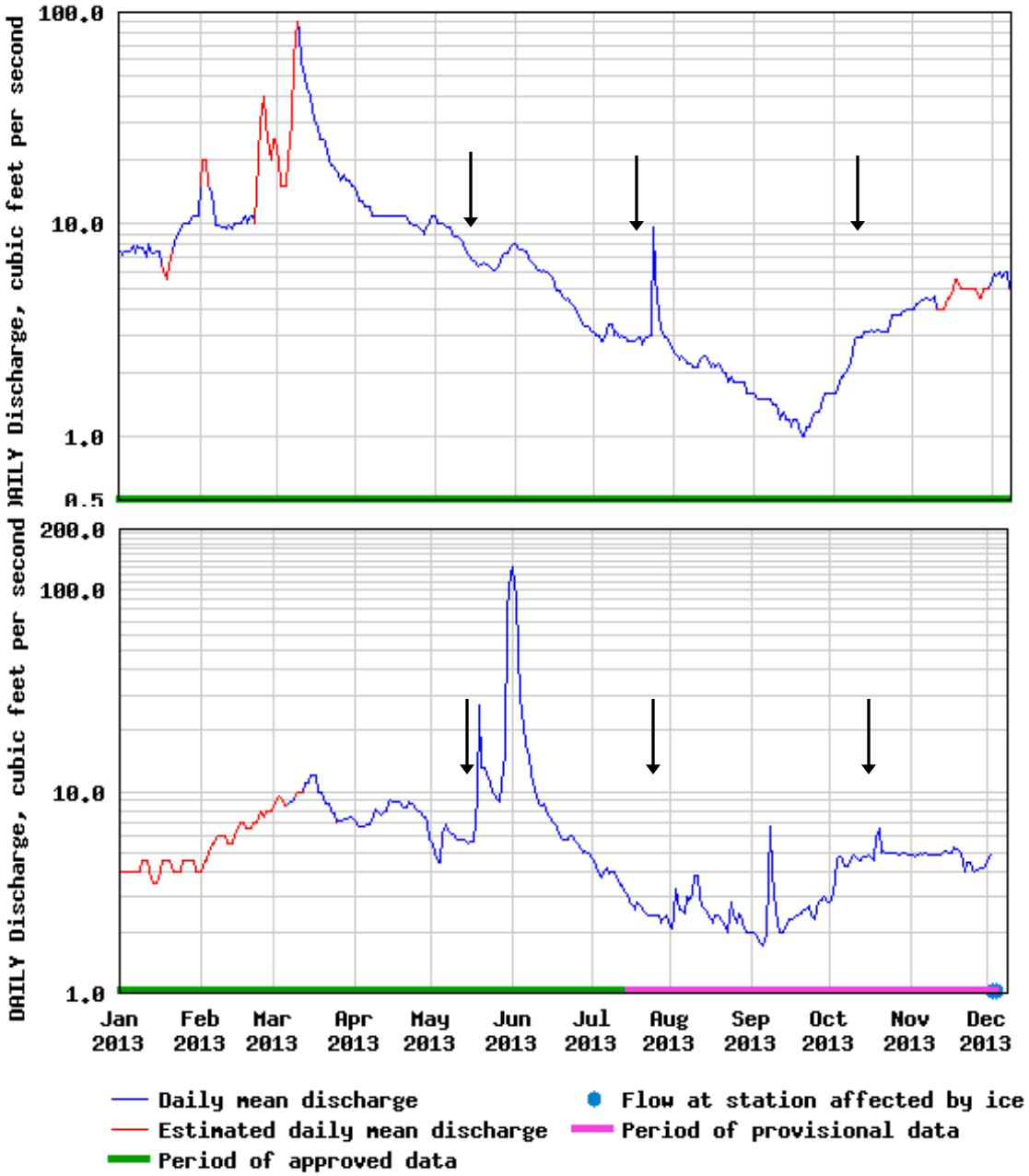
Table 1. *Otter Creek Coal Study Site Characteristics. GPS Locations at the top (T) and bottom (B) of the assessment reach. Aquatic Ecological System (AES) code defined in text followed Stagliano (2005).*

Site Code	Site Name	Type	AES code	Latitude	Longitude	Elev (m)	Comment
Otter_23	Tenmile Creek (T)	Control	D005/E005	45.43409	-106.13403	961	Dry during May and July, small pool during Oct. visit
Otter_23	Tenmile Creek (B)	Control	D005/E005	45.43465	-106.13253	958	
Otter_22	Otter Creek 22 (T)	Control	D005/C005	45.43035	-106.14428	951	Top of reach ~60m below Tenmile Creek road, proceeded 300m downstream
Otter_22	Otter Creek 22 (B)	Control	D005/C005	45.43274	-106.14366	948	
Otter_16	Otter Creek 16 (T)	Impact	C005	45.48514	-106.16487	938	Top of reach ~60m above the stream crossing and 240m below
Otter_16	Otter Creek 16 (B)	Impact	C005	45.48365	-106.16725	937	
Otter_3m	Threemile Creek (T)	Impact	E005	45.51054	-106.16288	933	Dry during all visits
Otter_3m	Threemile Creek (B)	Impact	E005	45.50955	-106.16960	928	
Otter_2	Otter Creek 2 (T)	Impact	C005	45.50475	-106.17493	929	Site surveyed for fish during all visits, downstream of road crossing
Otter_2	Otter Creek 2 (B)	Impact	C005	45.50561	-106.17561	928	
Otter_JT	Otter Creek JT (T)	Down	C005	45.55675	-106.21798	910	Top of reach ~80m below ranch road culvert to 300m downstream
Otter_JT	Otter Creek JT (B)	Down	C005	45.55782	-106.21770	909	
Otter_1A	Home Creek (B)	Down	D005/E005	45.54483	-106.18717	952	Bottom of reach ~500m above road crossing, then 300m upstream
Otter_1A	Home Creek (T)	Down	D005/E005	45.54422	-106.18947	950	

Average yearly discharge for 2013 was 7.7 cfs versus 14.6 cfs in 2011 and 3.9 cfs in 2010, which is still substantially higher than the 35 year average of 4.7 cfs (USGS 2012, 2013). Discharge during the 2013 May sampling visit (7 cfs) was similar to 2012, but only one third that of 2011 (19 cfs), while the summer and fall visits were closer to average baseflows at 2.5 and 5 cfs, respectively. Discharge patterns of the 2013 hydrograph were very different than in 2012, with virtually no early spring pulse and a very high rainfall-related pulse in late-May (Figure 1). During this fall's survey, we sampled during a day-long, wet snow/sleet storm that caused Otter Creek to increase by ~2 cfs overnight. Habitat assessments, herpetofauna, macroinvertebrate and fish surveys were

performed during seasonally similar dates at the same sites visited in 2011 and 2012. All stream reaches were visually and aurally surveyed for amphibians and reptiles during all visits.

Figure 1. *Discharge reported at the USGS gage in Ashland, MT for 2012 (top) and 2013 (bottom). Arrows indicate date of sampling visit.*



Habitat Assessments

The stream assessment reach was divided into 10 equally spaced transects according to BLM and EMAP protocols (BLM 2008a; Lazorchak et al. 1998). The downstream transect was marked (GPS, flagging and photo point) as the bottom of the reach and all ecological assessment protocols started from this point and continued upstream for 300m (designated the assessment area or "AA") to the marked top of the reach. Parameters recorded at each transect were: wetted-width

(WW), three channel depth measurements (¼, ½, ¾ ww distance), % large woody debris, substrate and riparian shading. On-site habitat assessments were conducted using the rapid assessment protocol developed for the BLM by the National Aquatic Assessment Team (scores 0-24) (BLM 2008a). The process for determining Proper Functioning Condition followed Pritchard et al. (1993). Basic water parameters (temperature, TDS, pH, conductivity) were recorded prior to biological sampling using a Horiba H-10 water monitor, calibrated for the higher conductivity range. The Livestock Use Index ("Cowpie" CPI) was assessed by walking a randomly chosen 75m transect on both sides of the stream channel in the riparian area within the assessment area and counting all the old and new cowpies (higher CPI equals high cow usage). The goal of these evaluations is to characterize local reach geomorphology, riparian and in-stream habitat, and characteristics that influence aquatic community integrity. Sites ranking higher using these protocols are determined to have higher quality local reach-scale habitat.

Macroinvertebrate Communities

Macroinvertebrate communities were sampled semi-quantitatively from each of the 10 transects within the 300m assessment reach using the EMAP Reach-Wide protocol (Lazorchak et al. 1998). Sampling started at the downstream transect (A) or #10 in the BLM protocol, and proceeded upstream alternating sampling with the 500-micron D-frame net to the left, right or center of the stream channel, so a systematic sampling of all habitats is achieved (Figure 2). The ten multi-habitat kicks/jabs were composited into a 20 liter bucket and processed according to BLM protocols (2008b). The organic portion on the sieve was transferred to one or two 1 liter Nalgene bottles, labeled and preserved in 95% ethanol and brought to the MTNHP lab in Helena for processing (sorting, identification and data analysis) following protocols outlined by the BLM (2008b) and MTDEQ (2006). Macroinvertebrates were identified to the lowest taxonomic level (MTDEQ 2006), counted, imported into EDAS (Jessup 2006), and biological metrics were calculated from the data using the Montana Department of Environmental Quality's newest multimetric macroinvertebrate (MMI) protocols (Jessup et al. 2005, Feldman 2006). Metric results were scored using the MTDEQ bioassessment criteria and each sample categorized as

Figure 2. *Macroinvertebrate sampling procedure at Otter 1A.*

Table 2. *Impairment determination thresholds from the MTDEQ MMI and O/E (RIVPACS) models.*

Ecoregion	RIVPACS	MMI	Impairment Determination
Mountain	≥ 0.8 or ≤ 1.2	≥ 63	Not impaired
	< 0.8 or > 1.2	< 63	Impaired
Low Valley	≥ 0.8 or ≤ 1.2	≥ 48	Not impaired
	< 0.8 or > 1.2	< 48	Impaired
Eastern Plains	≥ 0.8 or ≤ 1.2	≥ 37	Not impaired
	< 0.8 or > 1.2	< 37	Impaired

nonimpaired or impaired according to threshold values (37 for Eastern Plains Streams, Table 2). The macroinvertebrate MMI score is based upon a series of metrics that measure attributes of benthic macroinvertebrate communities that are sensitive to condition changes in the stream (in the form of pollution or pollutants) including the Hilsenhoff Biotic Index (HBI) (MTDEQ 2006). The index score represents the condition of the macroinvertebrate community at the time the sample was collected within that past year. If the index score is below the impairment threshold, the individual metrics can be used to provide insight as to why the communities are different from the reference condition (Barbour et. al 1999, Jessup et. al. 2005). Spring and fall macroinvertebrate samples were collected outside the range of the MTDEQ recommended sampling time frame (June 1st-September 15th) (MTDEQ 2006), but this time frame was largely derived for mountain streams.

Fish and Amphibian Surveys

Fish sampling within the 300 meter stream assessment reach was conducted with 6 and 9 meter straight seines in 25-30 m increments, seining in a downstream direction toward a block seine (Figure 3, protocols in Bramblett et al. 2005). Fish captured in a blocked section were transferred to holding buckets until the reach was completed, unless the reach was broken up by riffles, impassable or dry sections; in this case, fish were processed and released within the section of capture. Fish holding in the buckets were identified to species (Holton and Johnson 2003), enumerated, examined for external anomalies (e.g. deformities, eroded fins, lesions, and tumors; DELT), and then released. A fish anomaly score based on the number of individuals with anomalies divided by the total number of individuals collected (%) was calculated for each survey. In general fish are more likely to develop anomalies including deformities, tumors, and parasites in areas with degraded water quality (USGS 2000). At least 10% of the individuals of a species were measured for total length in millimeters (TL mm) to obtain size structure data. Young-of-the-year fish less than 20 mm (TL) were noted on the field sheet (not included in the totals) and released. Voucher specimens were only taken in the case of uncertain field identifications, and were preserved in 10% buffered formalin. These will be deposited with the Montana State University Collections. Adult amphibians or reptiles encountered while seining or walking the designated stream reach were counted and recorded even if they were not captured in the seine. All stream reaches were visually and aurally surveyed for amphibians or reptiles during all visits.

Figure 3. *Block seine set in fall at Otter Creek JT Reach #2.*

Analysis of the sampled fish communities used Integrated Biotic Indices (IBI) designed for wadable prairie streams (Bramblett et. al 2005) and derived Observed/Expected (O/E) Fish Models (Stagliano 2011) to detect impairment in the biological integrity of the sites. Proper classification is

important when determining biological integrity (Hawkins and Norris 2000) and expected species richness. Stream reaches of Otter Creek have become dry in previous years (Stagliano, pers. observation. 2005-2008), thus placing certain stream sections within the D005 classification. We have characterized reference condition indicator assemblages for these ecosystem types previously (Stagliano 2005), which are used here to compare to our site-specific observed species. The expected number of native fish species for a D005 classified reference stream is 2.5-3.75, while the expected number of fish for a C005 stream is 5.5-8.5 depending on watershed area; dividing the observed number of native fish species at a site by the expected number derives a percentage compared to reference condition (>0.8 or 80% = unimpaired) (Table 1). The IBI originally proposed by Karr (1981) involved the calculation of a series of 12 metrics evaluating different attributes of the fish community (i.e. species richness, tolerance to pollutants, trophic status) (Table 3). The 10 metrics used for the prairie streams were adjusted for watershed area to calculate an overall score between 0 and 100. Bramblett et al. (2005) did not propose threshold criteria for good, fair, and poor biological integrity for these scores. Therefore, we applied percentiles above the null criteria (no fish present score) at >30% indicates good to excellent biological integrity, 10-30% fair/good biological integrity, 0-10% indicated poor to fair biological integrity and scores below the null are indicative of poor biological integrity or severely impaired (Appendix A).

Table 3. *Fish metrics and classification of fishes captured during the Otter Creek Study (2013).*

Species	Scientific Name	Trophic *	Feeding Habitat†	Repro Guild‡	General Tolerance **	Origin ††	Total Length 3 years
Catostomidae							
White sucker	*Catostomus commersoni*	OM	BE	LO	TOL	N	229
Cyprinidae							
Common Carp	*Cyprinus carpio*	OM	BE		TOL	I	381
Brassy minnow	*Hybognathus hankinsoni*	HB	BE		MOD	N	81
Fathead Minnow	*Pimephales promelas*	OM	GE	TOL§	TOL	N	76
Golden Shiner	*Notemigonus crysoleucas*	OM	WC		MOD	I	102
Lake Chub	*Couesius plumbeus*	OM	GE		MOD	N	140
Sand Shiner	*Notropis stramineus*	OM	GE	LO	MOD	N	61
Centrarchidae							
Green Sunfish	*Lepomis cyanellus*	IC	GE	TOL§	TOL	I	102
Pumpkinseed	*Lepomis gibbosus*	IC	GE	TOL§	MOD	I	89
Ictaluridae							
Black Bullhead	*Ameiurus melas*	IC	BE	TOL§	TOL	I	152

*HB = herbivore (> 90% plants or detritus); IC = invertivore/carnivore (>25% both invertebrates and vertebrates); IN = invertivore; OM = omnivore(25-90% plants or detritus)
† BE = benthic; GE = generalist; WC = water column: Brown (1971); Scott and Crossman (1973); Becker (1983)
‡ LO=Litho-obligate Reproductive Guild; Scott and Crossman (1973); Pflieger (1997); Barbour et al. (1999)
§ Tolerant reproductive strategists are not litho-obligates, use parental care at spawning site: Scott and Crossman (1973); Pflieger (1997)
** INT = intolerant; MOD = moderately tolerant: TOL = tolerant; Barbour et al. (1999);
†† N = native; I – introduced; Brown (1971); Holton and Johnson (2003)

Results

We classified seven stream reaches in the study area: four Otter Creek mainstem sites are Perennial Prairie Streams (C005), and three tributaries are classified as Great Plains Intermittent Prairie Streams (D005-Home Creek, E005-Tenmile Creek and Threemile Creek) (Table 1). The Intermittent Prairie Stream (E005) in Montana is naturally fishless 80% of the time; therefore, absence of fish, in itself, should not be viewed as a biological impairment (e.g. Threemile and Tenmile Creek). Amphibian populations, especially the northern leopard frog were highest at Home Creek (Otter_1A) (Table 6), which had a mix of permanent pools and fishless sections.

Habitat Evaluations. Of the seven sampling reaches evaluated within the study area, we found three in Proper Functioning Condition (PFC) with a stable trend and four ranked Functional at Risk (FAR) (Appendix C). Reasons that sites ranked FAR were due to structural habitat alteration by cattle with associated high livestock use indices (CPI values) (Home Creek {Otter_1A}, Threemile Creek {Otter_3m} and Otter #16-fall) (Figure 4) or anthropogenic stream manipulation (Otter Creek JT and Otter Creek #16). Highest site integrity scores using both the BLM Habitat and PFC Assessment methods were recorded at the Otter Creek #22 and JT, Denson and Trusler reaches (Table 7). Point conductivity measurements recorded at all Otter Creek mainstem sites and tributaries across all seasons were above the threshold for impairment levels (>500µs, DEQ 2006b, Appendix C), and Home Creek site had visible signs of natural gas seepage from the sediments. Percentage of silt in the benthic substrates has not significantly changed for any monitored reach during the three years of the study (Appendix C).

Figure 4. *Structurally cattle damaged reach, Home Creek.*

Macroinvertebrate Communities: Overall, 78 unique macroinvertebrate taxa were reported from the 13 macroinvertebrate assessment samples (Appendix B). One MT species of concern (SOC), the mayfly, *Caenis youngi* was collected at sites Otter Creek #16 and #22 (Appendix B). Stoneflies (P)

were not present at any sites, so the EPT taxa reported per site usually consisted of two species of tolerant mayflies (E), and one or two species of caddisfly (T); the highest EPT richness at any site was six species at the Otter_16 summer (Table 4, Appendix B). Average macroinvertebrate taxa richness per site was 29.1 and the highest taxa richness was 37 taxa reported at the Otter JT site during the fall survey (Table 4). There were no significant differences in total taxa richness, EPT taxa, or the Hilsenhoff Biotic Index (HBI) between mainstem treatments (ANOVA, $p > 0.05$). Using the MTDEQ multimetric index (MMI), four of the five sites (11 of 13 samples) were ranked non-impaired (good to excellent biological integrity), while two samples, one from Tenmile (Otter_23) and Home Creek (Otter_1A) were ranked impaired (Table 4, Figure 5).

Table 4. *Macroinvertebrate sample characteristics and selected metrics used in the MTDEQ MMI (see Methods). Underlined MMI values are considered impaired. Ind.= Individuals*

Site ID	Collection Date	# of Ind. ID'ed	Total Per Sample	Total Taxa	Plains MMI Index	EPT Taxa	% EPT	HBI	% Non Insect
Otter_23t2f	10/14/2013	484	484	12	<u>32.6</u>	0	0.0	7.0	6.8
OTTER_22t2	5/17/2013	516	2064	24	58.5	2	3.9	7.2	40.3
OTTER_22t2s	7/16/2013	899	7,192	35	51.9	4	33.6	7.9	40.8
OTTER_22t2f	10/14/2013	506	2,024	35	54.7	4	9.6	7.8	56.2
OTTER_16t2	5/16/2013	612	1224	27	61.2	5	12.4	7.2	32.7
OTTER_16t2s	7/16/2013	534	1,068	32	53.7	6	27.3	7.3	14.2
OTTER_16t2f	10/14/2013	528	1,056	32	53.4	5	22.7	7.1	22.9
OTTER_JTt2	5/17/2013	750	1,500	30	47.5	5	4.3	6.9	25.1
OTTER_JTt2s	7/17/2013	503	2012	35	55.1	4	6.2	7.7	10.7
OTTER_JTt2f	10/15/2013	503	2012	37	46.7	5	11.5	7.3	11.3
OTTER_1At2	5/16/2013	542	3,252	26	38.4	0	0.0	7.7	66.1
OTTER_1At2s	7/16/2013	560	4478	25	<u>29.6</u>	1	0.01	7.7	55.7
OTTER_1At2f	10/15/2013	538	2150	28	43.7	1	0.01	7.6	38.9

No site had consistently high MMI scores across all seasons, though spring visits trended toward higher scores in 2013 (Figure 5). Stream sites that maintained flowing, connected water scored higher with the MMI than sites with interrupted pools. Otter Creek mainstem MMI scores were significantly higher than those in the tributaries (F-Test, $p < 0.01$) (Figure 5). Macroinvertebrate MMI's did not significantly differ between Otter Creek mainstem site classes (Control, Impact or

Downstream) or years (F-test, p>0.05) (Figures 6 and 7); this is despite the fish communities reflecting an overall decrease in biotic integrity as you proceed downstream (Figure 11).

Figure 5. *DEQ MMI scores across sites and seasons. Line is the MMI impairment threshold at 37.*

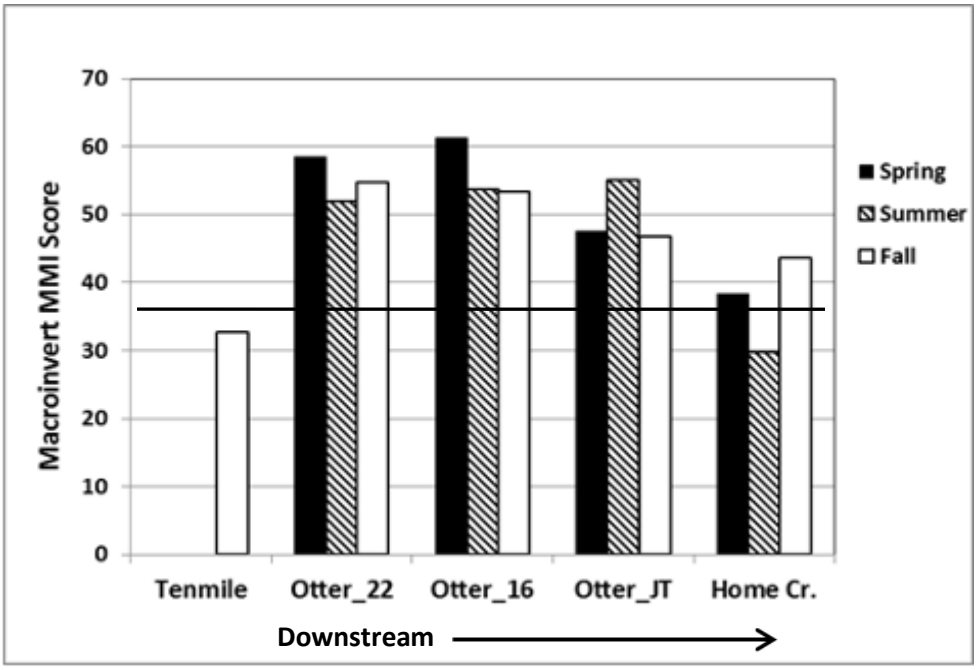
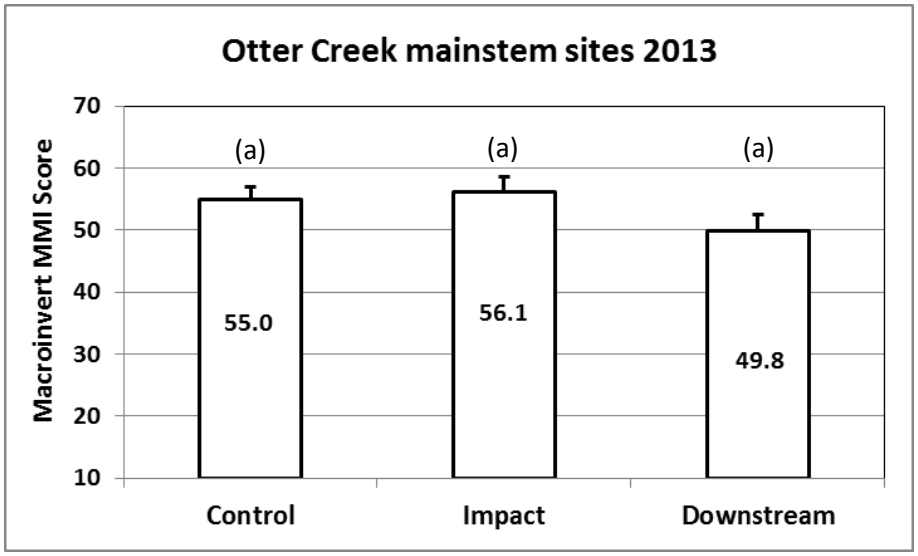


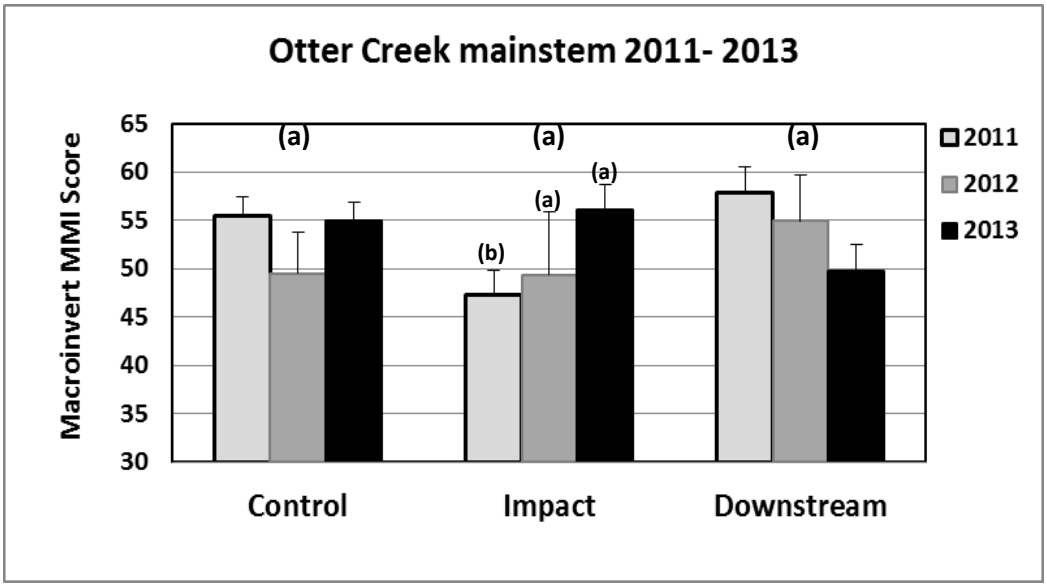
Figure 6. *Average MMI scores by site type. (a) = no significant differences between treatments.*



Over the three years of monitoring, macroinvertebrate integrity scores are stable at the control site, trending significantly upward at the Impact site (between 2011 and 2013, p=0.02) and

downward, but not significantly at the downstream site (between 2011 and 2013, p= 0.17) (Figure 7).

Figure 7. *Average macroinvertebrate MMI scores by treatment and year. Error bars are standard error (SE). (a) = no significant differences between treatments.*



Fish Communities. In total, we performed 15 fish surveys during 2013; 12 at the four mainstem Otter Creek reaches and three surveys in one tributary stream during spring, summer and fall. Overall, ten fish species (five native/five introduced) were identified from 16,215 individuals collected during 15 surveys (Table 5). No additional species were added in 2013 to those we reported in 2012, and in fact, that new introduced species, the golden shiner which was widespread in 2012, was reported from only one site (Otter_16) during spring and summer surveys and then at no sites in the fall of 2013. Average total fish species per Otter Creek mainstem site across all seasons was 6.7 (± 0.5 SE), a slight decrease from 2012 (7.0), while the tributary sites surveyed averaged 1.5 species (Table 5). Brassy minnows, a potential species of concern (PSOC), had the highest site occupancy rate of 100% (15 of 15 visits) followed by lake chubs, fathead minnows, and white suckers at 80% and 67% (12 and 10 out of 15 visits), respectively (Table 5 and 6). Lake chubs edged out fathead minnows in 2013 to account for the highest proportion of total individuals collected at 28% (Table 6). The most diverse fish site in the study area was Otter Creek #16 with nine species, while sites with the highest % of native species were Otter Creek JT (five spp.) and Home Creek (two native spp.) (Table 5). Otter Creek #16 had the highest number of

introduced species of any site (5 spp.) and the highest percentage of them in the fish community (93%) (Figure 14). Using Montana's Prairie Fish IBI, 9 of the 15 fish visits ranked non-impaired (good biological integrity), five were slightly impaired and Otter #16 fall was moderately impaired (poor integrity) (Table 5, Figure 8). As we observed in 2012, fish biotic integrity decreased going downstream in the Otter Creek mainstem (Figure 9) and seasonally with lower scores recorded during the fall (Figure 8). In 2013, Student T-tests of fish IBI scores of the Control Site were not significantly different than either the Impact ($p= 0.089$) or the Downstream site ($p=0.24$), but the O/E scores of the Control were significantly different than Impact sites ($p=0.018$) and the Downstream site ($p=0.036$) (Figures 9, 10). Despite no significance in 2013, combining the three monitoring years for analysis showed fish IBI scores are significantly higher at the control site than the Impact ($p=0.006$) or Downstream sites ($p=0.05$) (Figure 11). The O/E scores tracked the IBI in most cases, except at Otter Impact site #2 summer, where the O/E showed non-impairment (0.91), but the IBI score (54) indicated impaired fish integrity.

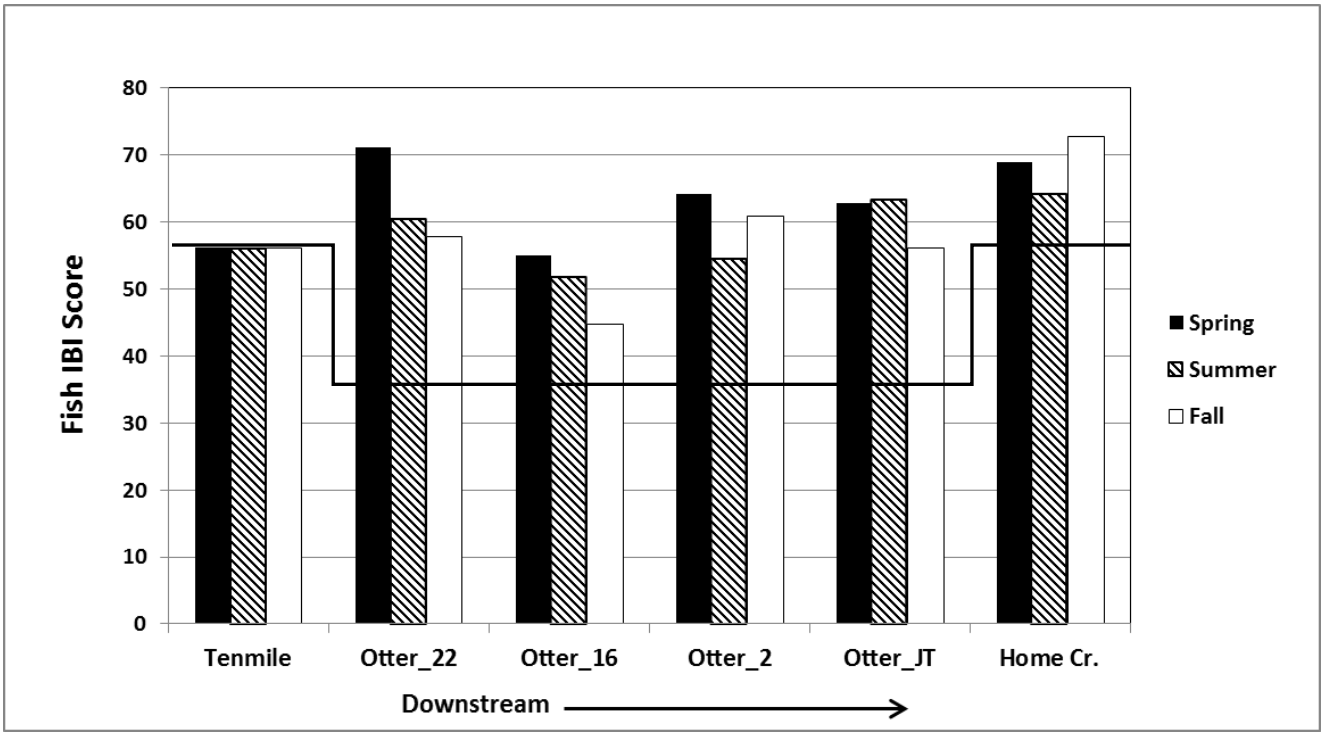
Table 5. *Fish abundance, IBI's and O/E results for the 6 sites that have reported fish. ns = not seined during visit (dry). Underlined bolded values are fish communities that ranked biologically unimpaired.*

	OTTER_23			OTTER_22			OTTER_16			OTTER_2			OTTER_JT			OTTER_1A			
	May	**Jul**	**Oct**	**May**	**Jul**	**Oct**	**May**	**Jul**	**Oct**	**May**	**Jul**	**Oct**	**May**	**Jul**	**Oct**	**May**	**Jul**	**Oct**	**Total**
Black Bullhead*	ns	ns	ns	18	351	0	149	595	18	18	7	0	0	0	2	0	0	0	**1157**
Brassy Minnow	ns	ns	ns	513	670	88	109	434	6	11	53	60	13	15	2	39	44	32	**2086**
Common Carp*	ns	ns	ns	0	0	0	62	248	189	0	11	8	10	23	14	0	0	0	**564**
Fathead Minnow	ns	ns	ns	28	0	15	22	87	6	42	35	0	1318	1085	774	2	12	0	**3425**
Lake Chub	ns	ns	ns	2825	945	79	74	298	0	210	14	26	43	75	4	0	0	8	**4601**
Green Sunfish*	ns	ns	ns	3	35	29	6	25	0	25	4	8	0	0	0	0	0	0	**133**
Golden Shiner*	ns	ns	ns	0	0	0	59	236	0	0	0	0	0	0	0	0	0	0	**295**
Pumpkinseed*	ns	ns	ns	3	32	20	53	211	90	0	0	0	0	0	10	0	0	0	**418**
Sand Shiner	ns	ns	ns	0	0	0	0	0	0	0	4	0	1060	900	234	0	0	0	**2198**
White Sucker	ns	ns	ns	265	159	15	133	533	0	25	4	0	53	98	54	0	0	0	**1339**
Total # species	0	0	0	7	6	6	9	9	5	6	8	4	6	6	8	2	2	2	**10**
Native Species	0	0	0	4	3	4	4	4	2	4	5	2	5	5	5	2	2	2	**5**
Total Individuals	0	0	0	3653	2192	246	667	2666	309	329	130	101	2495	2196	1094	41	56	40	**16,215**
IBI	56.1	56.1	56.1	**71.1**	**60.5**	57.8	55.0	51.9	44.7	**64.1**	54.5	**60.9**	**62.8**	**63.3**	56.1	**69.0**	**64.3**	**72.8**	
O/E	0	0	0	**1.07**	**0.80**	**1.07**	0.73	0.73	0.36	0.73	**0.91**	0.36	0.67	0.67	0.67	**0.82**	**0.82**	**0.82**	
O/E %	0	0	0	**106.7**	**80.0**	**106.7**	72.7	72.7	36.4	72.7	**90.9**	36.4	66.7	66.7	66.7	**81.6**	**81.6**	**81.6**	

* Denotes introduced species not native to Montana.

In 2013, fish IBI scores decreased going downstream to the Impact sites and then rebounded further downstream, but IBI scores of the Control Site were not significantly different than either the Impact (p= 0.089) or the Downstream site (p=0.24) using Student T-tests (Figure 9). The O/E scores of the Control were significantly different than Impact sites (p=0.018) and the Downstream site (p=0.036) (Figure 10). The O/E scores agreed with the IBI for indicating impairment in most cases (13 of 16), except at Otter Impact site #2 Summer, where the O/E showed non-impairment (0.91), while the IBI score (54) indicates impaired fish integrity (Figure 12). Likewise with the fall survey at Otter #22 where the O/E indicates an intact fish community, but the IBI indicates slight impairment.

Figure 8. *Fish IBI scores across sites and seasons. Line is the null IBI threshold (fish absent).*



Further evaluations into the relationship of the O/E to the IBI need to be addressed for stream sites with increasing numbers of non-native fish individuals, because the O/E only scores native fish that are expected to occur at a frequency > 0% within a reference condition reach.

Figure 9. *Average fish IBI scores by site type. (a) = no significant differences between treatments.*

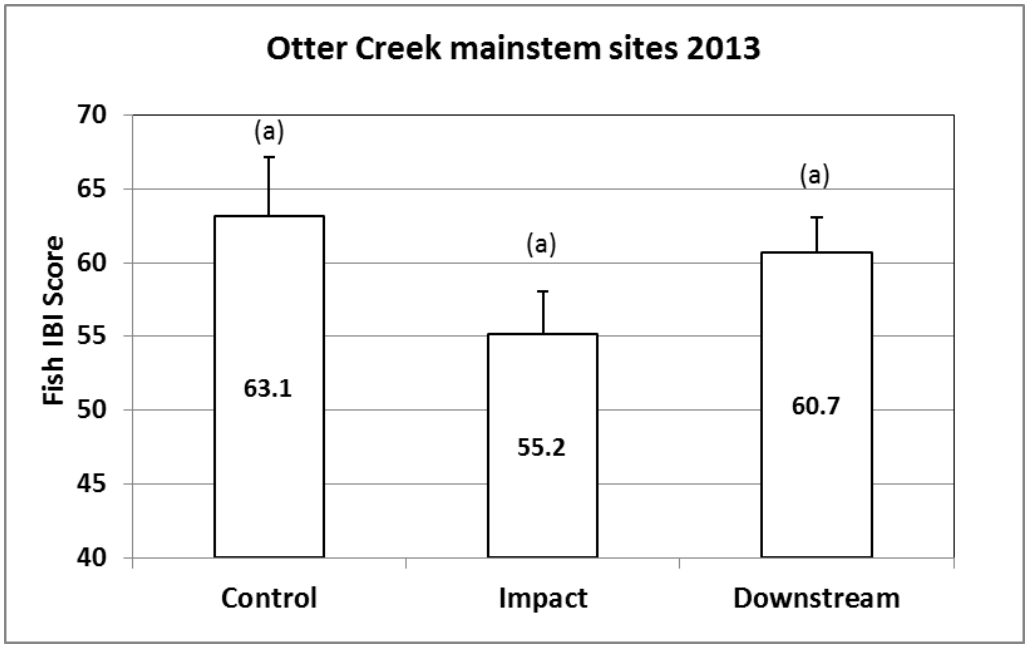


Figure 10. *Average O/E scores by site type. (a) = no significant differences between treatments.*

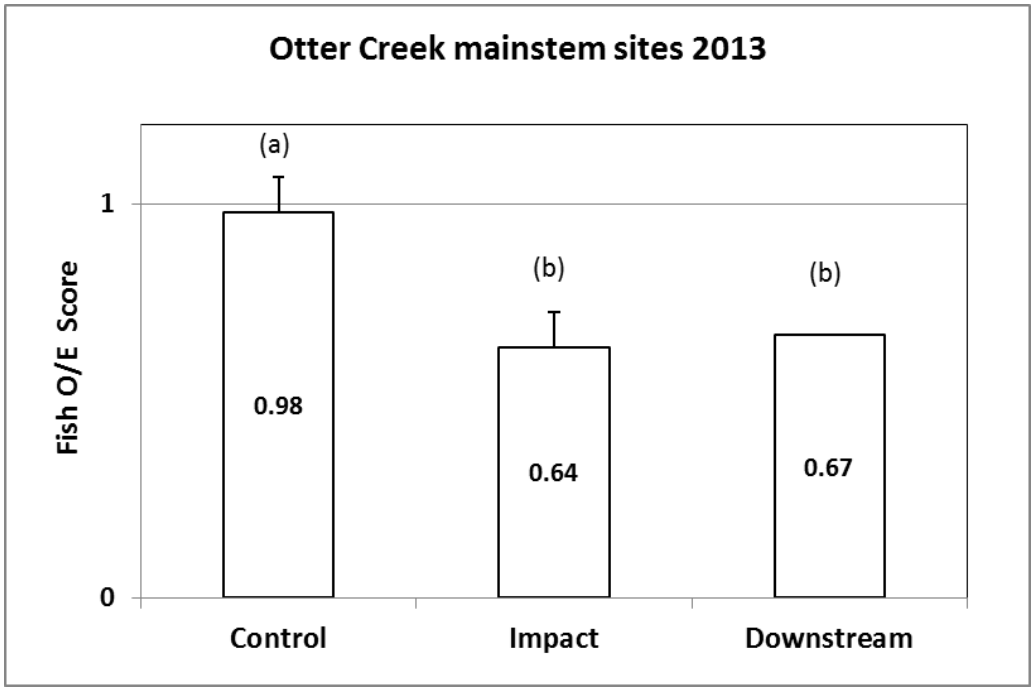


Figure 11. *Average fish IBI scores by treatment and year. Error bars are standard error (SE). (a) = no significant differences between treatments.*

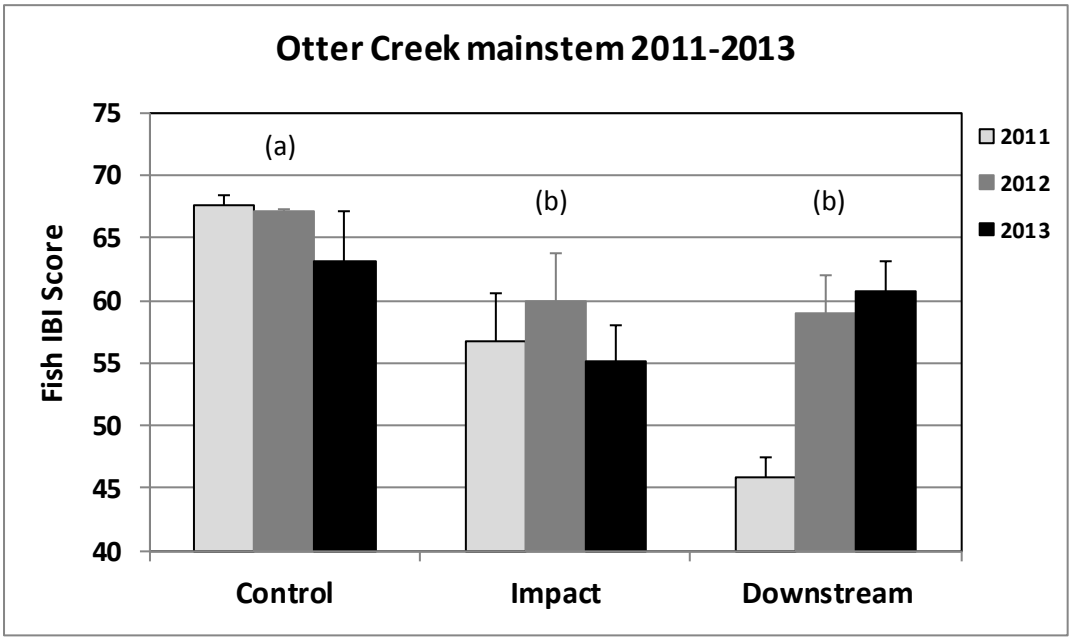
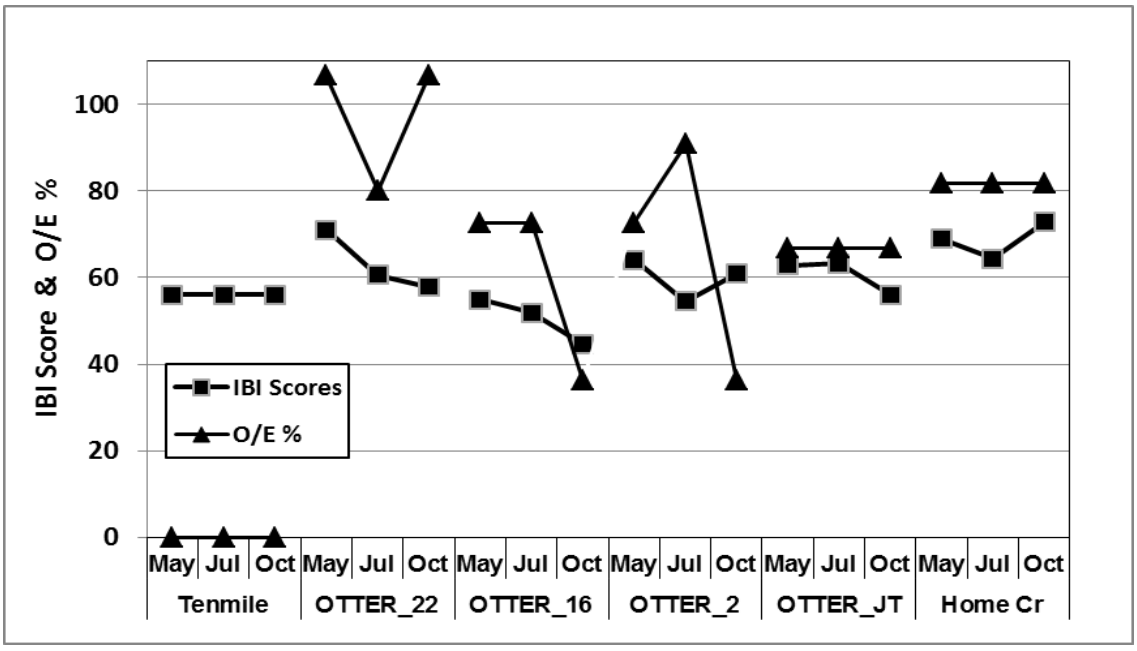


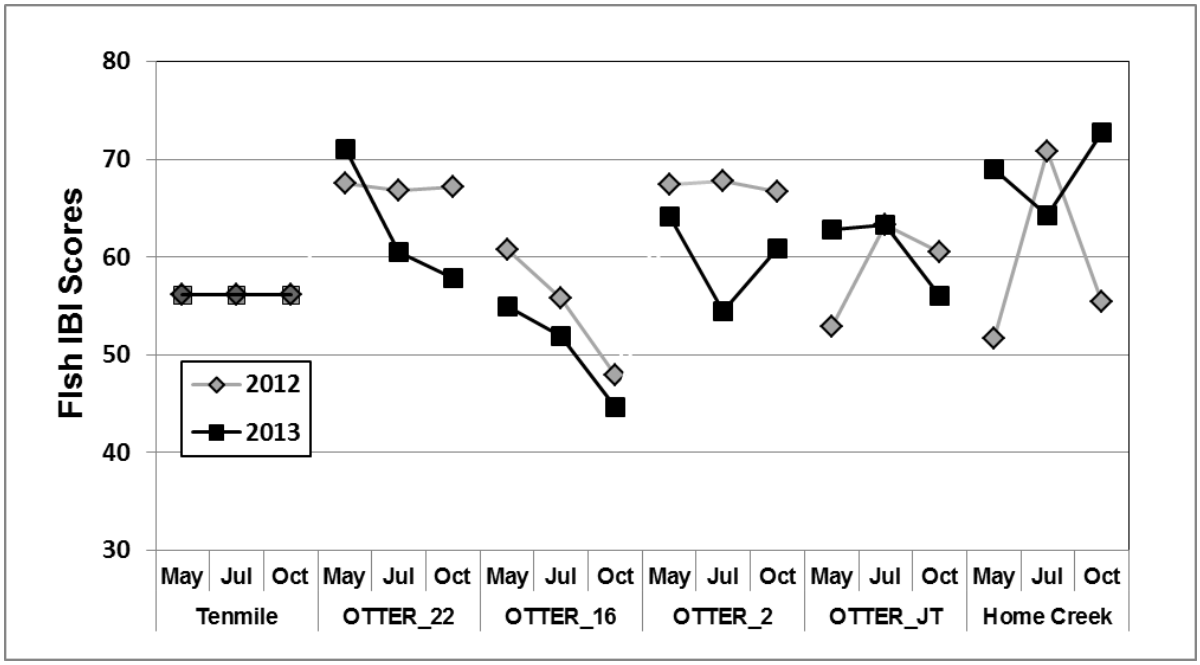
Figure 12. *2013 Fish IBI scores compared to O/E model (%) scores across sites and seasons.*



Fish IBI scores in 2013 showed similar seasonal patterns as in 2012, except with much higher IBI scores recorded during the Otter_JT spring survey and significantly lower IBI scores at Otter_2 during all visits (T-Test, $p<0.05$) (Figure 13). Otter Creek #16 exhibited decreasing seasonal fish

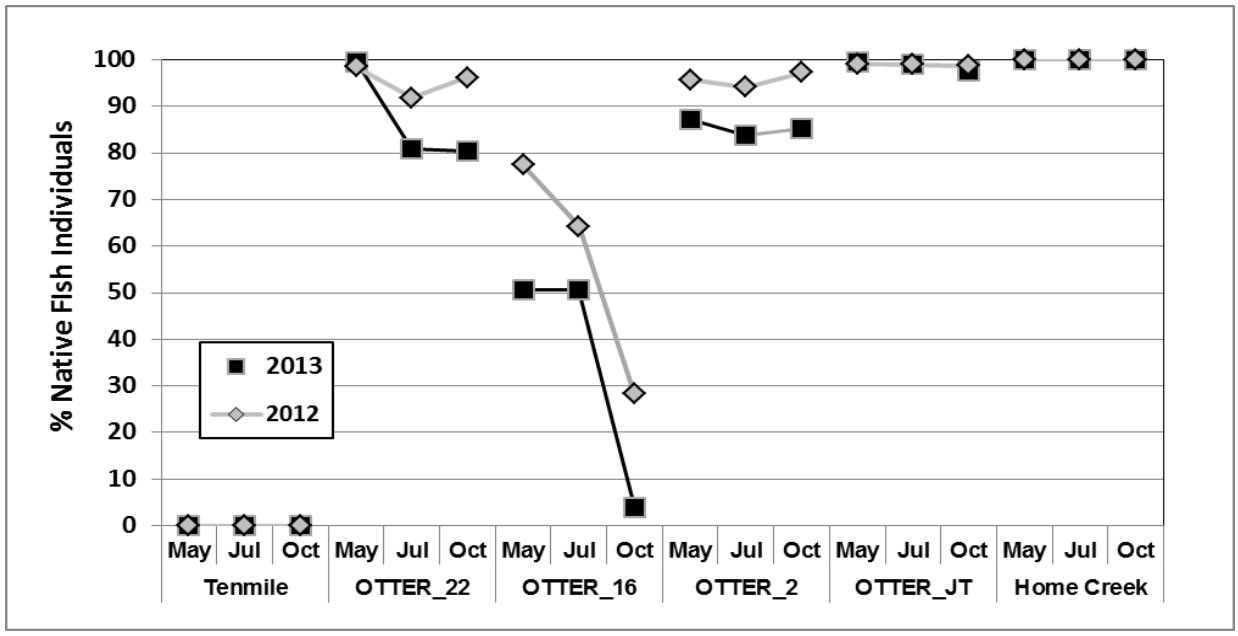
IBI scores during both years, while Otter Creek #22 began to show this trend in 2013 (Figure 13). This lower integrity is significantly correlated with the decrease in the percentage of native fish individuals collected during visits (Figure 14).

Figure 13. *Comparison of 2013 and 2012 Fish IBI scores across sites and seasons.*



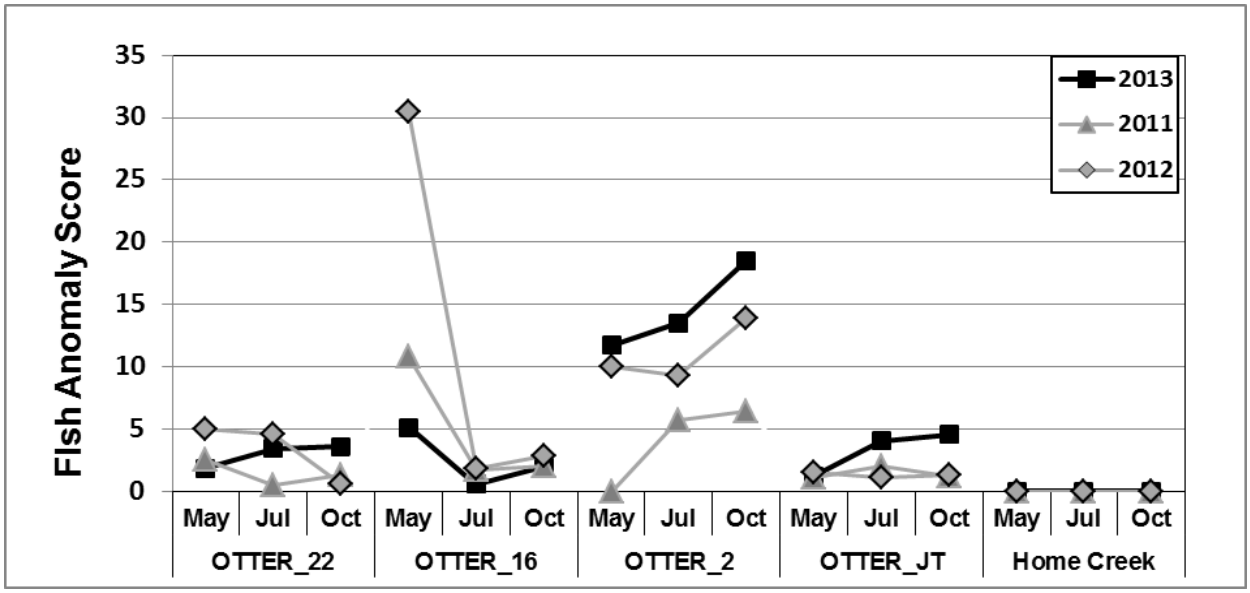
Otter Creek site 16 was heavily infested with introduced species during all 2013 seasonal visits representing 50%, 51% and 96% of the fish sampled, respectively. Percent native fish captured per survey continued to decline for 3 of the 4 mainstem Otter Creek Sites between 2012 and 2013 (Figure 14). All mainstem Otter Creek sites reported introduced species present during all surveys in 2013 (Table 5), but native fish species still dominated the percentage of total individuals of reaches except at Otter Creek #16 (Figure 14). The highest percentage of native fish has been consistently reported at Otter JT for 2012 and 2013, while in the first year of the study it was Otter Creek #22 (Stagliano 2011). It is likely that the "higher" water years since 2011 have favored the intrusion of non-native fish further upstream into Otter Creek mainstem reaches. Home Creek (Otter_1A) still maintains its fully native fish assemblage (Figure 14), likely due to an impassable barrier between Otter Creek and the monitoring reach.

Figure 14. *Comparison of 2013 and 2012 Native Fish Percentage (%) across sites and seasons.*



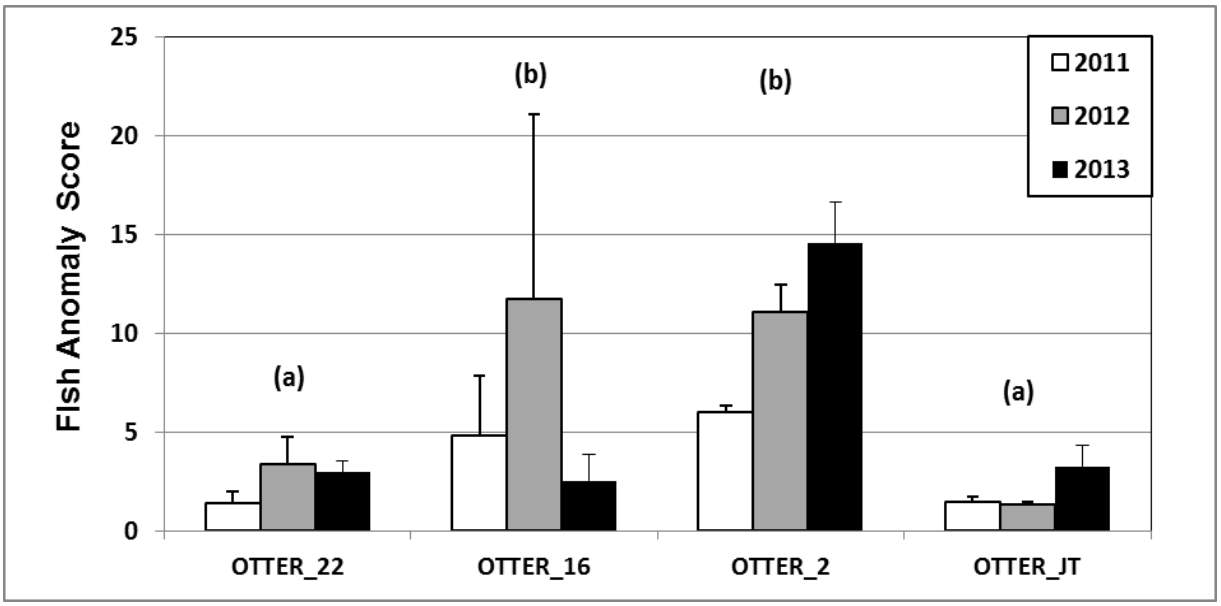
We report on the fish anomalies detected during the three sampling years (Figure 15). The overall highest percent of fish with anomalies occurred in spring at Otter_16 (31%), while consistently high anomaly scores were reported at Otter_2 during all seasons in 2013, increasing each year since 2011, especially in the fall (Figure 15). We reported large numbers of fish with lesions and yellow grub in the fall of 2011 at the Otter_JT site (Stagliano 2012), but because the

Figure 15. *Fish anomaly scores in 2013, 2012 and 2011 by sites and seasons.*



total fish catch was so abundant (~20,000 fish per 300m), the actual % anomalies was low. Home Creek communities have very low fish densities and never reported an anomaly during any survey; neither did the Tenmile Creek spring 2011 fish survey. Student T-Test analysis showed that fish anomaly scores were significantly higher in the Impact Reaches (Otter #16 and #2) than either the Control (p=0.026) or Downstream reaches (p=0.018) (Figure 16). Otter Creek site #2 continues to report significantly higher numbers of fish with anomalies since 2011 (Figure 16).

Figure 16. *Average fish anomaly scores by year and site. (a) = no significant differences between treatments.*



Amphibian and Reptile Observations. Overall, nine herpetofauna species were visually observed, collected in dipnets/seines or aurally recorded in conjunction with the 2013 surveys (Table 6). Otter Creek sites #22 and #16 were the most species rich in 2013 reporting five herpetofuana species cumulatively across all seasons. Of the four amphibian species detected, the Northern Leopard Frog (*Lithobates pipiens*) had the highest site occupancy, occurring at four of seven sites (seven detections), followed by the Woodhouse's Toad (*Anaxyrus woodhousii*) and Boreal Chorus Frog (*Pseudacris maculata*) recorded at three sites, five and four visit detections, respectively (Table 6). Boreal Chorus Frog adults were detected vocally calling during the spring visits at two sites (Home Creek and Otter_16) and as juveniles (n=15) at Tenmile Creek

(Otter_23), despite the stream channel being dry during the spring and summer visits. Woodhouse's toad juveniles (n=3) were also reported at Tenmile Creek during the summer visit. Tiger salamanders (*Ambystoma tigrinum*) continue to use Home Creek (Otter_1A) as a breeding area, as evidenced by larvae (n=8) captured while seining for fish during the summer visits. We also recorded five reptile species (in order of site occurrence): Painted Turtle (*Chrysemys picta*), Snapping Turtle (*Chelydra serpentina*) (MTSOC), Western Rattlesnake (*Crotalus viridis*), Gopher snake (*Pituophis catenifer*) and Terrestrial Garter Snake (*Thamnophis elegans*) (Table 6, Figure 17).

Table 6. Vertebrates (Species Code) recorded during the 2013 Otter Creek Surveys. Frequency of Occurrence (FO) calculated from the # of visits detected / # of total visits. Herps (n=21) and Fish (n=15). % of Total Herp Individuals. * = Introduced Species

Herpetofauna	Visits Detect	F of O	% of total
Northern Leopard Frog (RAPI)	7	0.33	0.41
Woodhouse's Toad (BUWO)	5	0.24	0.09
Boreal Chorus Frog (PSMA)	4	0.19	0.28
Painted Turtle (CHPI)	4	0.19	0.05
Snapping Turtle (CHSE)	2	0.10	0.03
Tiger Salamander (AMTI)	2	0.10	0.11
Western Rattlesnake (CRVI)	2	0.10	0.03
Terrestrial Gartersnake (THEL)	1	0.05	0.01
Gopher Snake (PICA)	1	0.05	0.01
Fish			
Brassy Minnow (BRMI)	15	1.00	0.13
Lake Chub (LACH)	12	0.80	0.28
Fathead Minnow (FAMI)	12	0.80	0.21
White Sucker (WHSU)	10	0.67	0.08
Black Bullhead (BLBU)*	8	0.53	0.07
Common Carp (CARP)*	8	0.53	0.03
Green Sunfish (GRSU)*	8	0.53	0.01
Pumpkinseed (PUMP)*	7	0.47	0.03
Sand Shiner (SASH)	4	0.27	0.14
Golden Shiner (GOSH)*	2	0.13	0.02

Figure 17. *Snapping Turtle (adult) and Terrestrial Garter Snake (right) from Otter Creek #22 and JT.*

Conclusions

Otter Creek mainstem reaches within the area proposed for the mine site (i.e. Impact zone) continue to show higher impairment levels in biological integrity than the Control or Downstream reaches. Spatial and temporal patterns of aquatic community composition and biotic integrity were similar between the 2013 and 2012 surveys, with a notable increase in the percentage of non-native fish occurring across most sites, especially at the Impact sites in the fall. This pattern may be related to the unusual discharge pattern in 2013 with a high flow event in early summer during warmer water temperatures potentially increasing the colonization of large numbers of introduced fish upstream. This increase in non-native fish led to the subsequent decrease in community integrity seen in summer and fall surveys. While 2013 sampling data showed similarities in macroinvertebrate integrity patterns, there were some significant deviations in fish integrity results from 2012. Fish biological integrity of the upstream control reach of Otter Creek (Otter #22) remains significantly higher and more stable than the lower Otter Creek reaches over the three years of monitoring, but even this site has suffered from the effects of increasing numbers of introduced species. Sites surveyed within the Impact Zone (Otter #2 and #16) exhibit some measure of impairment for all indicators of fish integrity (IBI's, O/E, % Native and % Fish Anomalies). Otter Creek #16 continues to exhibit decreasing seasonal trends in the fish IBI during all years and reports increasingly higher numbers of introduced fish in the surveys. A potential reason for this accumulation of introduced fish at Otter #16 may be related to the graveled road crossing or another putative barrier upstream of the reach acting as a barrier to fish movement during low water periods, but this is unconfirmed. The fish anomaly score may somehow be related to the increasing numbers of introduced fish at the Impact Sites because the % of anomalies is also significantly higher at these sites. Oddly enough, fish anomalies largely affect native species with white suckers, fathead minnows and lake chubs showing the highest infection rates. This may indicate that native species are more sensitive to infections when stressed by high densities of introduced fish, especially potential predators, such as black bullhead.

Despite the large discharge pulse of approximately 100 cfs in the early summer, stream flows this year were lower overall than in 2012, but still were above the 35 year average. The spring and summer 2013 visits to Tenmile Creek revealed a dry stream channel while in previous years small isolated pools were reported, but surprisingly Tenmile Creek still reported two species of juvenile

amphibians (PSMA and BUWO). Spring visits had the highest detection rate for herpetofauna as reptiles were coming out of hibernation and amphibians were in breeding mode. This indicates that there are breeding pools adjacent to the survey reach, either in the stream or in off channel wetlands.

Outside of coal extraction, manageable threats to this watershed include grazing and livestock use around the riparian areas. Moderate use of the riparian zone by cattle in the basin can have strong local effects resulting in sedimentation, stream widening where cattle access the stream and loss of functional channel hydrology. Introductions of game fish (green sunfish, bullheads or pumpkinseeds) or forage fish (golden shiners) in stock ponds anywhere in the watershed can pose potential problems for native fish, as these introduced fish become permanent residents, outcompete or prey upon the native fish and contribute to overall community degradation. Diverse aquatic communities with high biological integrity are usually correlated with good riparian condition and habitat quality (Allen et al. 1997). Thus, effective riparian zone management (e.g. fencing, pasture rotation) while grazing cattle would contribute to intact vegetation buffers and less sediment in the aquatic environment (George et al. 2002). During all years of the study, macroinvertebrate communities assessed by the MTMMI ranked few sites as impaired, even those with an obviously impaired riparian condition and in-stream habitat degradation. The effectiveness of macroinvertebrate communities in assessing prairie stream impairment, especially for sediment, is still under debate in Montana. Thus, placing more emphasis on the fish communities or habitat assessment scores in fishless streams may be necessary in monitoring intermittent prairie streams.

Assessment results from the habitat, fish and macroinvertebrate surveys combined to rank the following sites from highest biological integrity to lowest within their aquatic ecological classification codes:

Northwestern Great Plains Perennial Prairie Stream (AES code C005)-1) Otter Creek #22, 2) Otter Creek J Trusler, 3) Otter Creek #2, 4) Otter Creek #16

Northwestern Great Plains Intermittent Stream-(AES D005)-1) Home Creek (Otter_1A)

Great Plains Intermittent Fishless Stream (AES code E005)-1) Tenmile Creek, 2) Threemile Creek

Site Photos

Otter Creek #22 (control) during spring (left) and summer 2013 visits (right)


Otter Creek JT (downstream): summer (left) and fall (right) 2013 visits looking downstream


Otter Creek #2 (impact): spring (left) and fall (right) visit 2013 looking downstream.


Site Photos

Otter Creek #16 (Impact) spring (left) and fall (right) looking downstream from road crossing.

Northwestern Great Plains Intermittent Stream-(AES D005)-1) Home Creek 1A, 2) Tenmile Creek

Home Creek (Otter 1A) during the spring (left) and fall (right) visits.

Site Photos

Home Creek (Otter 1A) during the summer (left) and fall (right) 2013 visits with a duckweed bloom


Great Plains Intermittent Fishless Prairie Stream (AES code E005)-1) Tenmile Creek, 2) Threemile Creek

Tenmile Creek (Otter_23) in the spring (left) and summer (right) 2013 visits.


Site Photos: Threemile Creek (Otter 3m) during the spring (left) and summer (right) 2013 visits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Appendix A. *Rawdata and IBI metric calculation from fish data collected from Otter Creek Coal Tract Sites*

	Spring 2013											
	Otter23		**Otter22**		**Otter16**		**Otter2**		**OtterJT**		**Otter1A**	
Black Bullhead	0.0		17.5		148.8		17.5		0.0		0.0	
Brassy Minnow	0.0		512.5		108.5		10.5		12.5		39.0	
Common Carp	0.0		0.0		62.0		0.0		10.0		0.0	
Fathead Minnow	0.0		27.5		21.7		42.0		1317.5		2.0	
Lake Chub	0.0		2825.0		74.4		210.0		42.5		0.0	
Green Sunfish	0.0		2.5		6.2		24.5		0.0		0.0	
Golden Shiner	0.0		0.0		58.9		0.0		0.0		0.0	
Pumpkinseed Sunfish	0.0		2.5		52.7		0.0		0.0		0.0	
Sand Shiner	0.0		0.0		0.0		0.0		1060.0		0.0	
White Sucker	0.0		265.0		133.3		24.5		52.5		0.0	
Total # species	0.0		7.0		9.0		6.0		6.0		2.0	
Native Species	0.0		4.0		4.0		4.0		5.0		2.0	
Native Families	0.0		2.0		2.0		2.0		2.0		1.0	
Total Individuals	0.0		3652.5		666.5		329.0		2495.0		41.0	
# Minnow Species Thrive	0.0		3.0		3.0		3.0		4.0		2.0	
Proportion of tolerant individuals	0.00		8.56		64.65		32.98		55.31		4.88	
# Sucker + Catfish Species	0.0		2.0		2.0		2.0		1.0		0.0	
% Insectivorous Minnows	0.0		77.3		11.2		63.8		44.2		0.0	
# Benthic Invertivore Species	0.0		1.0		1.0		1.0		0.0		0.0	
% Litholphilic Spawners	0.0		7.3		20.0		7.4		44.6		0.0	
% Parental Care	0.00		1.23		25.58		18.09		52.81		4.88	
% Native to Montana	0.0		99.4		50.7		87.2		99.6		100.0	
# Long Lived Species	0.0		4.0		5.0		1.0		4.0		2.0	

	Otter23		**Otter22**		**Otter16**		**Otter2**		**OtterJT**		**Otter1A**	
Metrics	Adjust Value	Score	Adjust Value	Score	Adjust Value	Score	Adjust Value		Adjust Value	Score	Adjust Value	Score
Number of Native Fish Species to Montana	11.6	64.7	10.3	57.4	10.1	56.0	10.0	55.3	10.8	59.9	13.3	73.7
Number of Native Fish Families to Montana	2.1	39.5	3.2	58.7	3.1	57.8	3.1	57.4	3.1	56.8	3.1	56.7
Proportion of tolerant individuals	0.0	100.0	8.6	90.9	64.7	31.6	33.0	65.1	55.3	41.5	4.9	94.8
Number of Sucker and Catfish Species	7.1	77.1	5.9	64.2	5.8	62.6	5.7	61.8	4.6	49.8	6.9	74.7
Proportion out of the Total Number of Fish That Were Insect eating Minnows	0.0	0.0	77.3	106.2	11.2	15.3	63.8	87.7	44.2	60.7	0.0	0.0
Total Number of Species That Prefer to Eat Insects That Live on the Stream Bottom	5.5	93.1	4.0	68.3	4.9	83.3	4.8	82.4	4.8	81.0	5.3	90.2
Proportion of the Total Number of Fish That Require Rocks to Lay Eggs	0.0	0.0	7.3	8.7	20.0	24.1	7.4	9.0	44.6	53.8	0.0	0.0
Proportion of the Total Number of Individuals That Do Not Require Rocks, But Have Parental Care of Eggs	0.0	100.0	1.2	98.6	25.6	70.9	18.1	79.4	52.8	39.9	4.9	94.5
Proportion of the Total Number of Fish Sampled That Were Native to Montana	0.0	0.0	99.4	99.4	50.7	50.7	87.2	87.3	99.6	99.6	100.0	100.0
Number of Long-Lived Native Species	8.5	86.9	5.7	58.1	9.5	97.3	5.4	55.4	8.3	84.9	10.2	104.7
		561.4		710.6		549.6		640.9		628.0		689.5
IBI Score		**56.14**		**71.06**		**54.96**		**64.09**		**62.80**		**68.95**

Appendix A. (cont.) *Rawdata and IBI metric calculation from fish data collected from Otter Creek Coal Tract Sites*

	Summer 2013											
	Otter23		**Otter22**		**Otter16**		**Otter2**		**OtterJT**		**Otter1A**	
Black Bullhead	0.0		351.0		595.2		7.0		0.0		0.0	
Brassy Minnow	0.0		669.6		434.0		52.5		15.0		44.0	
Common Carp	0.0		0.0		248.0		10.5		23.0		0.0	
Fathead Minnow	0.0		0.0		86.8		35.0		1085.0		12.0	
Lake Chub	0.0		945.0		297.6		14.0		75.0		0.0	
Green Sunfish	0.0		35.1		24.8		3.5		0.0		0.0	
Golden Shiner	0.0		0.0		235.6		0.0		0.0		0.0	
Pumpkinseed Sunfish	0.0		32.4		210.8		0.0		0.0		0.0	
Sand Shiner	0.0		0.0		0.0		3.5		900.0		0.0	
White Sucker	0.0		159.3		533.2		3.5		98.0		0.0	
Total # species	0.0		6.0		9.0		8.0		6.0		2.0	
Native Species	0.0		3.0		4.0		5.0		5.0		2.0	
Native Families	0.0		2.0		2.0		2.0		2.0		1.0	
Total Individuals	0.0		2192.4		2666.0		129.5		2196.0		56.0	
# Minnow Species Thrive	0.0		2.0		3.0		4.0		4.0		2.0	
Proportion of tolerant individuals	0.00		24.88		64.65		45.95		54.92		21.43	
# Sucker + Catfish Species	0.0		2.0		2.0		2.0		1.0		0.0	
% Insectivorous Minnows	0.0		43.1		11.2		13.5		44.4		0.0	
# Benthic Invertivore Species	0.0		1.0		1.0		1.0		0.0		0.0	
% Litholphilic Spawners	0.0		7.3		20.0		5.4		45.4		0.0	
% Parental Care	0.00		16.01		25.58		32.43		49.41		21.43	
% Native to Montana	0.0		80.9		50.7		83.8		99.0		100.0	
# Long Lived Species	0.0		1.0		2.0		1.0		4.0		1.0	
	Otter23		**Otter22**		**Otter16**		**Otter2**		**OtterJT**		**Otter1A**	
Metrics	Adjust Value		Adjust Value		Adjust Value		Adjust Value		Adjust Value		Adjust Value	Score
Number of Native Fish Species to Montana	11.6	64.7	9.3	51.8	10.1	56.0	11.1	61.5	10.8	59.9	13.3	73.7
Number of Native Fish Families to Montana	2.1	39.5	3.2	58.7	3.1	57.8	3.1	57.8	3.1	56.8	3.1	56.7
Proportion of tolerant individuals	0.0	100.0	24.9	73.7	64.7	31.6	45.9	51.4	54.9	41.9	21.4	77.3
Number of Sucker and Catfish Species	7.1	77.1	5.9	64.2	5.8	62.6	5.8	62.6	4.6	49.8	6.9	74.7
Proportion out of the Total Number of Fish That Were Insect eating Minnows	0.0	0.0	43.1	59.2	11.2	15.3	13.5	18.6	44.4	61.0	0.0	0.0
Total Number of Species That Prefer to Eat Insects That Live on the Stream Bottom	5.5	93.1	4.0	68.3	4.9	83.3	4.9	83.3	4.8	81.0	5.3	90.2
Proportion of the Total Number of Fish That Require Rocks to Lay Eggs	0.0	0.0	7.3	8.8	20.0	24.1	5.4	6.5	45.4	54.8	0.0	0.0
Proportion of the Total Number of Individuals That Do Not Require Rocks, But Have Parental Care of Eggs	0.0	100.0	16.0	81.8	25.6	70.9	32.4	63.1	49.4	43.8	21.4	75.6
Proportion of the Total Number of Fish Sampled That Were Native to Montana	0.0	0.0	80.9	80.9	50.7	50.7	83.8	83.8	99.0	99.0	100.0	100.0
Number of Long-Lived Native Species	8.5	86.9	5.7	58.1	6.5	66.5	5.5	56.3	8.3	84.9	9.2	94.5
		561.4		605.5		518.9		544.9		632.9		642.9
IBI Score		**56.14**		**60.55**		**51.89**		**54.49**		**63.29**		**64.29**

Appendix A. (cont.) *Rawdata and IBI metric calculation from fish data collected from Otter Creek Coal Tract Sites*

	Fall 2013											
	Otter23		**Otter22**		**Otter16**		**Otter2**		**OtterJT**		**Otter1A**	
Black Bullhead	0.0		0.0		18.0		0.0		2.0		0.0	
Brassy Minnow	0.0		88.0		6.0		60.0		2.0		32.0	
Common Carp	0.0		0.0		189.0		7.5		14.0		0.0	
Fathead Minnow	0.0		15.4		6.0		0.0		774.0		0.0	
Lake Chub	0.0		79.2		0.0		26.3		4.0		8.0	
Green Sunfish	0.0		28.6		0.0		7.5		0.0		0.0	
Golden Shiner	0.0		0.0		0.0		0.0		0.0		0.0	
Pumpkinseed Sunfish	0.0		19.8		90.0		0.0		10.0		0.0	
Sand Shiner	0.0		0.0		0.0		0.0		234.0		0.0	
White Sucker	0.0		15.4		0.0		0.0		54.0		0.0	
Total # species	0.0		6.0		5.0		4.0		8.0		2.0	
Native Species	0.0		4.0		2.0		2.0		5.0		2.0	
Native Families	0.0		2.0		2.0		2.0		2.0		1.0	
Total Individuals	0.0		246.4		309.0		101.3		1094.0		40.0	
# Minnow Species Thrive	0.0		3.0		2.0		2.0		4.0		2.0	
Proportion of tolerant individuals	0.00		24.11		68.93		14.81		77.15		0.00	
# Sucker + Catfish Species	0.0		1.0		1.0		0.0		2.0		0.0	
% Insectivorous Minnows	0.0		32.1		0.0		25.9		21.8		20.0	
# Benthic Invertivore Species	0.0		0.0		1.0		0.0		1.0		0.0	
% Litholphilic Spawners	0.0		6.3		0.0		0.0		26.3		0.0	
% Parental Care	0.00		6.25		7.77		0.00		70.93		0.00	
% Native to Montana	0.0		80.4		3.9		85.2		97.6		100.0	
# Long Lived Species	0.0		6.0		4.0		3.0		6.0		2.0	

	Otter23		**Otter22**		**Otter16**		**Otter2**		**OtterJT**		**Otter1A**	
Metrics	Adjust Value		Adjust Value		Adjust Value		Adjust Value		Adjust Value		Adjust Value	Score
Number of Native Fish Species to Montana	11.6	64.7	10.3	57.4	8.1	44.9	8.1	44.9	10.8	59.9	13.3	73.7
Number of Native Fish Families to Montana	2.1	39.5	3.2	58.7	3.1	57.8	3.1	57.8	3.1	56.8	3.1	56.7
Proportion of tolerant individuals	0.0	100.0	24.1	74.5	68.9	27.1	14.8	84.3	77.1	18.4	0.0	100.0
Number of Sucker and Catfish Species	7.1	77.1	4.9	53.3	4.8	51.7	3.8	40.8	5.6	60.7	6.9	74.7
Proportion out of the Total Number of Fish That Were Insect eating Minnows	0.0	0.0	32.1	44.1	0.0	0.0	25.9	35.6	21.8	29.9	20.0	27.5
Total Number of Species That Prefer to Eat Insects That Live on the Stream Bottom	5.5	93.1	3.0	51.3	4.9	83.3	4.9	83.3	4.8	81.0	5.3	90.2
Proportion of the Total Number of Fish That Require Rocks to Lay Eggs	0.0	0.0	6.3	7.5	0.0	0.0	0.0	0.0	26.3	31.7	0.0	0.0
Proportion of the Total Number of Individuals That Do Not Require Rocks, But Have Parental Care of Eggs	0.0	100.0	6.3	92.9	7.8	91.2	0.0	100.0	70.9	19.3	0.0	100.0
Proportion of the Total Number of Fish Sampled That Were Native to Montana	0.0	0.0	80.4	80.4	3.9	3.9	85.2	85.2	97.6	97.7	100.0	100.0
Number of Long-Lived Native Species	8.5	86.9	5.7	58.1	8.5	87.0	7.5	76.8	10.3	105.3	10.2	104.7
		561.4		578.2		446.9		608.8		560.8		727.7
IBI Score		**56.14**		**57.82**		**44.69**		**60.88**		**56.08**		**72.77**

Appendix B

Macroinvertebate taxa lists, abundance and metrics for the Otter Creek collection sites

Montana Bioassessment Report

Waterbody Name: Otter Creek Site 16 for the Coal Tracts Study **Benthic Sample ID:** 18127

Station ID: OTTER_16t2 **Rep. Num** 0

Reference Status: **STORET Activity ID:** OTTR16M-MAC-R

Site Classification: **Collection Date:** 05/19/2013

Latitude: **Collection Method:** MAC-R-500

Longitude: **Total Number of Individuals in Sample:** 1224

Sample Taxa List

Order:	*OTU name:*	*FinalID:*	*Individuals*	*Tol Val:*	*FFG:*	*Habit:*
Amphipoda	Hyalella	Hyalella azteca	160	8	CG	SW/SP
Basommatop	Lymnaeidae	Stagnicola caperata	40	6	CG	CN
Basommatop	Physa_Physella	Physella acuta	120	8	CG	CN
Basommatop	Planorbidae	Gyraulus parvus	40	6	CG	CN
Coleoptera	Dubiraphia	Dubiraphia vittata	96	6	SC/CG	"CN/50%, BU/50%"
Diptera	Chironominae	Chironomus	80	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Dicrotendipes	8	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Polypedilum	40	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Pseudochironomus	8	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Tanytarsus	80	7	CG/CF/PR	BU/CN/SP
Diptera	Orthocladiinae	Cricotopus	16		CG/SC	SP/BU
Diptera	Orthocladiinae	Psectrocladius	40		CG/SC	SP/BU
Diptera	Simuliidae	Simulium	8	6	CF	CN
Diptera	Tanypodinae	Ablabesmyia	16		PR	SP/BU
Diptera	Tanypodinae	Procladius	80		PR	SP/BU
Ephemeropte	Caenis	Caenis latipennis	56	8	CG	"SP/75%, CM/90%"
Ephemeropte	Callibaetis	Callibaetis	16	9	CG	"SW/10%, CN/90%"
Haplotaxida	Oligochaeta	Tubificidae	40	8	CG	BU
Hemiptera	Corixidae	Corixidae	40	9	PH/PR	SW
Odonata	Coenagrionidae	Enallagma	40	7	PR	CM
Odonata	Coenagrionidae	Ischnura	32	7	PR	CM
Odonata	Lestes	Lestes dryas	32	9	PR	SW
Odonata	Libellulidae	Libellula forensis	48	9	PR	SP
Odonata	Libellulidae	Sympetrum	8	9	PR	SP
Trichoptera	Cheumatopsyche	Cheumatopsyche	40	5	CF	CN
Trichoptera	Chimarra	Chimarra	8	4	CF	CN
Trichoptera	Limnephilus	Limnephilus	32	3	SH	CM/SP

Montana Bioassessment Report

Waterbody Name: Otter Creek Site 16 for the Coal Tracts Study **Benthic Sample ID:** 18128

Station ID: OTTER_16t2f **Rep. Num** 0

Reference Status: **STORET Activity ID:** OTR16fM-MAC-R

Site Classification: **Collection Date:** 10/14/2013

Latitude: **Collection Method:** MAC-R-500

Longitude: **Total Number of Individuals in Sample:** 528

Sample Taxa List

Order:	*OTU name:*	*FinalID:*	*Individuals*	*Tol Val:*	*FFG:*	*Habit:*
		Gyraulus circumstriatus	12			
		Leucorrhinia intacta	2			
Amphipoda	Hyalella	Hyalella azteca	54	8	CG	SW/SP
Basommatop	Lymnaeidae	Stagnicola caperata	10	6	CG	CN
Basommatop	Physa_Physella	Physella acuta	43	8	CG	CN
Basommatop	Planorbidae	Gyraulus parvus	6	6	CG	CN
Coleoptera	Dubiraphia	Dubiraphia vittata	55	6	SC/CG	"CN/50%, BU/50%"
Diptera	Ceratopogoninae	Culicoides	4	6	PR/CG	SP/BU/SW
Diptera	Ceratopogoninae	Probezzia	4	6	PR/CG	SP/BU/SW
Diptera	Chironominae	Chironomus	40	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Dicrotendipes	15	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Polypedilum	14	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Pseudochironomus	10	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Tanytarsus	21	7	CG/CF/PR	BU/CN/SP
Diptera	Dasyheleinae	Dasyhelea	4		CG	BU/SW
Diptera	Orthocladiinae	Cricotopus	20		CG/SC	SP/BU
Diptera	Orthocladiinae	Psectrocladius	10		CG/SC	SP/BU
Diptera	Simuliidae	Simulium	4	6	CF	CN
Diptera	Tanypodinae	Ablabesmyia	2		PR	SP/BU
Diptera	Tanypodinae	Procladius	20		PR	SP/BU
Ephemeropte	Caenis	Caenis latipennis	75	8	CG	"SP/75%, CM/90%"
Ephemeropte	Callibaetis	Callibaetis	2	9	CG	"SW/10%, CN/90%"
Haplotaxida	Oligochaeta	Tubificidae	6	8	CG	BU
Hemiptera	Corixidae	Corixidae	20	9	PH/PR	SW
Odonata	Coenagrionidae	Enallagma	14	7	PR	CM
Odonata	Coenagrionidae	Ischnura	10	7	PR	CM
Odonata	Lestes	Lestes dryas	4	9	PR	SW
Odonata	Libellulidae	Sympetrum	2	9	PR	SP
Trichoptera	Cheumatopsyche	Cheumatopsyche	35	5	CF	CN
Trichoptera	Chimarra	Chimarra	4	4	CF	CN
Trichoptera	Limnephilus	Limnephilus	4	3	SH	CM/SP
Trombidiform	Acarina	Hydrodroma	2	5	PR	"SW/10%, CN/90%"

Montana Bioassessment Report

Waterbody Name: Otter Creek Site 16 for the Coal Tracts Study **Benthic Sample ID:** 18129

Station ID: OTTER_16t2s **Rep. Num** 0

Reference Status: **STORET Activity ID:** OTR16sM-MAC-R

Site Classification: **Collection Date:** 07/16/2013

Latitude: **Collection Method:** MAC-R-500

Longitude: **Total Number of Individuals in Sample:** 534

Sample Taxa List

Order:	*OTU name:*	*FinalID:*	*Individuals*	*Tol Val:*	*FFG:*	*Habit:*
		Gyraulus circumstriatus	4			
Amphipoda	Hyalella	Hyalella azteca	22	8	CG	SW/SP
Basommatop	Lymnaeidae	Pseudosuccinea columella	2	6	CG	CN
Basommatop	Lymnaeidae	Stagnicola caperata	10	6	CG	CN
Basommatop	Physa_Physella	Physella acuta	26	8	CG	CN
Basommatop	Planorbidae	Gyraulus parvus	4	6	CG	CN
Coleoptera	Dubiraphia	Dubiraphia vittata	4	6	SC/CG	"CN/50%, BU/50%"
Diptera	Ceratopogoninae	Probezzia	4	6	PR/CG	SP/BU/SW
Diptera	Chironominae	Chironomus	70	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Cryptochironomus	4	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Dicrotendipes	6	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Glyptotendipes	24	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Phaenopsectra	16	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Polypedilum	6	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Pseudochironomus	4	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Tanytarsus	24	7	CG/CF/PR	BU/CN/SP
Diptera	Dasyheleinae	Dasyhelea	8		CG	BU/SW
Diptera	Orthocladiinae	Cricotopus	40		CG/SC	SP/BU
Diptera	Orthocladiinae	Psectrocladius	20		CG/SC	SP/BU
Diptera	Simuliidae	Simulium	8	6	CF	CN
Diptera	Tanypodinae	Ablabesmyia	4		PR	SP/BU
Diptera	Tanypodinae	Procladius	30		PR	SP/BU
Ephemeropte	Caenis	Caenis latipennis	104	8	CG	"SP/75%, CM/90%"
Ephemeropte	Caenis	Caenis youngi	4	8	CG	"SP/75%, CM/90%"
Ephemeropte	Callibaetis	Callibaetis	2	9	CG	"SW/10%, CN/90%"
Haplotaxida	Oligochaeta	Tubificidae	12	8	CG	BU
Hemiptera	Corixidae	Corixidae	20	9	PH/PR	SW
Odonata	Coenagrionidae	Enallagma	12	7	PR	CM
Odonata	Libellulidae	Sympetrum	4	9	PR	SP
Trichoptera	Cheumatopsyche	Cheumatopsyche	4	5	CF	CN
Trichoptera	Hydroptila	Hydroptila	30	6	PH	CN
Trichoptera	Limnephilus	Limnephilus	2	3	SH	CM/SP

Montana Bioassessment Report

Waterbody Name: Home Creek Site 1A for the Coal Tracts Study **Benthic Sample ID:** 18130

Station ID: OTTER_1At2 **Rep. Num** 0

Reference Status: **STORET Activity ID:** OTTR1AM-MAC-R

Site Classification: **Collection Date:** 05/16/2013

Latitude: **Collection Method:** MAC-R-500

Longitude: **Total Number of Individuals in Sample:** 542

Sample Taxa List

Order:	*OTU name:*	*FinalID:*	*Individuals*	*Tol Val:*	*FFG:*	*Habit:*
		Ishnura	4			
		Tropisternis	24			
Amphipoda	Hyalella	Hyalella azteca	220	8	CG	SW/SP
Basommatop	Lymnaeidae	Stagnicola caperata	20	6	CG	CN
Basommatop	Physa_Physella	Physella acuta	100	8	CG	CN
Basommatop	Physa_Physella	Physella gyrina	6	8	CG	CN
Coleoptera	Coptotomus	Coptotomus longulus	4	5	PR	"CM (la), DI, SW (ad)"
COLEOPTE	ILYBIUS	ILYBIUS	4	5	PR	
Diptera	Ceratopogoninae	Bezzia	4	6	PR/CG	SP/BU/SW
Diptera	Chironominae	Chironomus	16	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Glyptotendipes	8	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Tanytarsus	20	7	CG/CF/PR	BU/CN/SP
Diptera	Dasyheleinae	Dasyhelea	4		CG	BU/SW
Diptera	Ephydridae	Ephydra	8	6	CG	BU
Diptera	Orthocladiinae	Corynoneura	8		CG/SC	SP/BU
Diptera	Orthocladiinae	Psectrocladius	28		CG/SC	SP/BU
Diptera	Sciomyzidae	Sepedon	8		PR	BU
Diptera	Tanypodinae	Procladius	4		PR	SP/BU
Haplotaxida	Oligochaeta	Tubificidae	4	8	CG	BU
Hemiptera	Corixidae	Corixidae	4	9	PH/PR	SW
Non-Insect ta	Ostracoda	Ostracoda	8		unk	SW
Odonata	Aeshna	Aeshna palmata	16		PR	CM
Odonata	Amphiagrion	Amphiagrion abbreviatum	4	7	PR	CM
Odonata	Coenagrionidae	Enallagma	16	7	PR	CM

Montana Bioassessment Report

Waterbody Name: Home Creek Site 1A for the Coal Tracts Study **Benthic Sample ID:** 18131

Station ID: OTTER_1At2f **Rep. Num** 0

Reference Status: **STORET Activity ID:** OTR1AfM-MAC-R

Site Classification: **Collection Date:** 10/15/2013

Latitude: **Collection Method:** MAC-R-500

Longitude: **Total Number of Individuals in Sample:** 2150

Sample Taxa List

Order:	*OTU name:*	*FinalID:*	*Individuals*	*Tol Val:*	*FFG:*	*Habit:*
		Callibaetis fluctuans	4			
		Proezzia	11			
		Tropisternis	32			
Amphipoda	Hyalella	Hyalella azteca	600	8	CG	SW/SP
Basommatop	Lymnaeidae	Stagnicola caperata	32	6	CG	CN
Basommatop	Physa_Physella	Physella acuta	188	8	CG	CN
Coleoptera	Berosus	Berosus	4	5	PH	"CM(la), DI,SW(ad)"
Coleoptera	Coptotomus	Coptotomus longulus	4	5	PR	"CM (la), DI, SW (ad)"
Coleoptera	Haliplus	Haliplus	28	8	PH	:N,CM (la), SW,CM (ad
Diptera	Ceratopogoninae	Bezzia	8	6	PR/CG	SP/BU/SW
Diptera	Ceratopogoninae	Culicoides	16	6	PR/CG	SP/BU/SW
Diptera	Ceratopogoninae	Probezzia	4	6	PR/CG	SP/BU/SW
Diptera	Chironominae	Chironomus	184	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Glyptotendipes	24	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Tanytarsus	216	7	CG/CF/PR	BU/CN/SP
Diptera	Dasyheleinae	Dasyhelea	24		CG	BU/SW
Diptera	Ephydridae	Ephydra	8	6	CG	BU
Diptera	Orthocladiinae	Corynoneura	24		CG/SC	SP/BU
Diptera	Orthocladiinae	Psectrocladius	473		CG/SC	SP/BU
Diptera	Orthocladiinae	Thienemanniella	8		CG/SC	SP/BU
Diptera	Tanypodinae	Procladius	22		PR	SP/BU
Haplotaxida	Oligochaeta	Tubificidae	16	8	CG	BU
Hemiptera	Corixidae	Corixidae	112	9	PH/PR	SW
Odonata	Aeshna	Aeshna palmata	8		PR	CM
Odonata	Coenagrionidae	Enallagma	88	7	PR	CM
Odonata	Coenagrionidae	Ischnura	12	7	PR	CM

Montana Bioassessment Report

Waterbody Name: Home Creek Site 1A for the Coal Tracts Study **Benthic Sample ID:** 18132

Station ID: OTTER_1At2s **Rep. Num** 0

Reference Status: **STORET Activity ID:** OTR1AsM-MAC-R

Site Classification: **Collection Date:** 07/16/2013

Latitude: **Collection Method:** MAC-R-500

Longitude: **Total Number of Individuals in Sample:** 2239

Sample Taxa List

Order:	*OTU name:*	*FinalID:*	*Individuals*	*Tol Val:*	*FFG:*	*Habit:*
		Callibaetis fluctuans	32			
		Tropisternis	48			
Amphipoda	Hyalella	Hyalella azteca	640	8	CG	SW/SP
Basommatop	Lymnaeidae	Stagnicola caperata	80	6	CG	CN
Basommatop	Physa_Physella	Physella acuta	512	8	CG	CN
Coleoptera	Berosus	Berosus	16	5	PH	"CM(la), DI,SW(ad)"
Coleoptera	Coptotomus	Coptotomus longulus	16	5	PR	"CM (la), DI, SW (ad)"
Coleoptera	Haliplus	Haliplus	128	8	PH	CN,CM (la), SW,CM (ad
Coleoptera	Rhantus	Rhantus binotatus	16		PR	"CM (la), DI, SW (ad)"
Diptera	Ceratopogoninae	Bezzia	16	6	PR/CG	SP/BU/SW
Diptera	Ceratopogoninae	Culicoides	32	6	PR/CG	SP/BU/SW
Diptera	Chironominae	Chironomus	224	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Glyptotendipes	16	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Tanytarsus	64	7	CG/CF/PR	BU/CN/SP
Diptera	Ephydridae	Ephydra	32	6	CG	BU
Diptera	Orthocladiinae	Corynoneura	80		CG/SC	SP/BU
Diptera	Orthocladiinae	Psectrocladius	80		CG/SC	SP/BU
Diptera	Sciomyzidae	Sciomyzidae	16		PR	BU
Diptera	Tanypodinae	Procladius	64		PR	SP/BU
Haplotaxida	Oligochaeta	Tubificidae	16	8	CG	BU
Hemiptera	Corixidae	Corixidae	96	9	PH/PR	SW
Odonata	Aeshna	Aeshna palmata	4		PR	CM
Odonata	Coenagrionidae	Enallagma	10	7	PR	CM
Odonata	Libellulidae	Sympetrum	1	9	PR	SP

Montana Bioassessment Report

Waterbody Name: Otter Creek Site 22 for the Coal Tracts Study **Benthic Sample ID:** 18133

Station ID: OTTER_22t2 **Rep. Num** 0

Reference Status: **STORET Activity ID:** OTTR22M-MAC-R

Site Classification: **Collection Date:** 05/17/2013

Latitude: **Collection Method:** MAC-R-500

Longitude: **Total Number of Individuals in Sample:** 2064

Sample Taxa List

Order:	*OTU name:*	*FinalID:*	*Individuals*	*Tol Val:*	*FFG:*	*Habit:*
Amphipoda	Hyalella	Hyalella azteca	144	8	CG	SW/SP
Basommatop	Physa_Physella	Physella acuta	320	8	CG	CN
Basommatop	Planorbidae	Gyraulus parvus	160	6	CG	CN
Coleoptera	Dubiraphia	Dubiraphia vittata	16	6	SC/CG	"CN/50%, BU/50%"
Diptera	Ceratopogoninae	Bezzia	16	6	PR/CG	SP/BU/SW
Diptera	Ceratopogoninae	Probezzia	32	6	PR/CG	SP/BU/SW
Diptera	Chironominae	Chironomus	48	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Cryptochironomus	32	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Dicrotendipes	16	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Glyptotendipes	80	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Microtendipes pedellus Gr.	320	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Polypedilum	16	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Tanytarsus	112	7	CG/CF/PR	BU/CN/SP
Diptera	Orthocladiinae	Psectrocladius	112		CG/SC	SP/BU
Diptera	Simuliidae	Simulium	64	6	CF	CN
Diptera	Tanypodinae	Procladius	192		PR	SP/BU
Ephemeropte	Caenis	Caenis latipennis	64	8	CG	"SP/75%, CM/90%"
Haplotaxida	Oligochaeta	Tubificidae	80	8	CG	BU
Hemiptera	Corixidae	Corixidae	32	9	PH/PR	SW
Non-Insect ta	Ostracoda	Ostracoda	128		unk	SW
Odonata	Coenagrionidae	Enallagma	32	7	PR	CM
Odonata	Coenagrionidae	Ischnura	16	7	PR	CM
Odonata	Libellulidae	Libellula pulchella	16	9	PR	SP
Trichoptera	Limnephilus	Limnephilus	16	3	SH	CM/SP

Montana Bioassessment Report

Waterbody Name: Otter Creek Site 22 for the Coal Tracts Study **Benthic Sample ID:** 18134

Station ID: OTTER_22t2s **Rep. Num** 0

Reference Status: **STORET Activity ID:** OTR22sM-MAC-R

Site Classification: **Collection Date:** 07/16/2013

Latitude: **Collection Method:** MAC-R-500

Longitude: **Total Number of Individuals in Sample:** 899

Sample Taxa List

Order:	*OTU name:*	*FinalID:*	*Individuals*	*Tol Val:*	*FFG:*	*Habit:*
		Helisoma trivolvis	1			
Amphipoda	Hyalella	Hyalella	107	8	CG	SW/SP
Basommatop	Lymnaeidae	Pseudosuccinea columella	1	6	CG	CN
Basommatop	Physa_Physella	Physella acuta	212	8	CG	CN
Basommatop	Planorbidae	Gyraulus parvus	13	6	CG	CN
BASOMMAT	Planorbidae	HELISOMA ANCEPS	3	6	CG	CN
Coleoptera	Berosus	Berosus	2	5	PH	"CM(la), DI,SW(ad)"
Coleoptera	Colymbetes	Colymbetes	1		PR	"CM(la), DI,SW(ad)"
Coleoptera	Haliplus	Haliplus	15	8	PH	:N,CM (la), SW,CM (ad
Coleoptera	Hydroporus	Hydroporus	7		PR	"CM (la), DI, SW (ad)"
Coleoptera	Peltodytes	Peltodytes	3	8	PH	:N,CM (la), SW,CM (ad
Diptera	Chironominae	Chironomus	2	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Dicrotendipes	5	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Glyptotendipes	23	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Microtendipes pedellus Gr.	2	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Tanytarsus	40	7	CG/CF/PR	BU/CN/SP
Diptera	Dixella	Dixella	1		CG	SW
Diptera	Orthocladiinae	Cricotopus	7		CG/SC	SP/BU
Diptera	Orthocladiinae	Psectrocladius	22		CG/SC	SP/BU
Diptera	Simuliidae	Simulium	4	6	CF	CN
Diptera	Tanypodinae	Ablabesmyia	20		PR	SP/BU
Diptera	Tanypodinae	Procladius	17		PR	SP/BU
Diptera	Tanypodinae	Thienemannimyia Gr.	6		PR	SP/BU
Ephemeropte	Caenis	Caenis latipennis	259	8	CG	"SP/75%, CM/90%"
Ephemeropte	Caenis	Caenis youngi	4	8	CG	"SP/75%, CM/90%"
Ephemeropte	Callibaetis	Callibaetis	36	9	CG	"SW/10%, CN/90%"
Haplotaxida	Oligochaeta	Tubificidae	5	8	CG	BU
Hemiptera	Corixidae	Corixidae	5	9	PH/PR	SW
Non-Insect ta	Ostracoda	Ostracoda	22		unk	SW
Odonata	Aeshna	Aeshna palmata	6		PR	CM
Odonata	Coenagrionidae	Enallagma	35	7	PR	CM
Odonata	Lestes	Lestes	6	9	PR	SW
Rhynchobdell	Glossiphoniidae	Glossiphonia complanata	2	9	PR	SW
Rhynchobdell	Glossiphoniidae	Helobdella stagnalis	2	9	PR	SW
Trichoptera	Limnephilus	Limnephilus	3	3	SH	CM/SP

Montana Bioassessment Report

Waterbody Name: Tenmile Creek Site 23 for the Coal Tracts Study
Benthic Sample ID: 18135
Station ID: Otter_23t2f
Rep. Num 0
Reference Status:
STORET Activity ID: OTR23fM-MAC-R
Site Classification:
Collection Date: 10/15/2011
Latitude:
Collection Method: MAC-R-500
Longitude:
Total Number of Individuals in Sample: 484

Sample Taxa List

Order:	*OTU name:*	*FinalID:*	*Individuals*	*Tol Val:*	*FFG:*	*Habit:*
Coleoptera	Agabus	Agabus	25	5	PR	"CM(la), DI,SW(ad)"
Coleoptera	Colymbetes	Colymbetes	5		PR	"CM(la), DI,SW(ad)"
Coleoptera	Coptotomus	Coptotomus longulus	6	5	PR	"CM (la), DI, SW (ad)"
Coleoptera	Rhantus	Rhantus	10		PR	"CM (la), DI, SW (ad)"
Diptera	Chironominae	Chironomus	30	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Tanytarsus	177	7	CG/CF/PR	BU/CN/SP
Diptera	Ephydridae	Ephydridae	13	6	CG	BU
Diptera	Orthocladiinae	Psectrocladius	145		CG/SC	SP/BU
Hemiptera	Corixidae	Corixidae	22	9	PH/PR	SW
Hemiptera	Corixidae	Sigara	18	9	PH/PR	SW
Non-Insect ta	Ostracoda	Ostracoda	33		unk	SW

Montana Bioassessment Report

Waterbody Name: Otter Creek Site 22 for the Coal Tracts Study **Benthic Sample ID:** 18136

Station ID: OTTER_2t2f **Rep. Num** 0

Reference Status: **STORET Activity ID:** OTR22fM-MAC-R

Site Classification: **Collection Date:** 10/14/2013

Latitude: **Collection Method:** MAC-R-500

Longitude: **Total Number of Individuals in Sample:** 1992

Sample Taxa List

Order:	*OTU name:*	*FinalID:*	*Individuals*	*Tol Val:*	*FFG:*	*Habit:*
		Callibaetis fluctuans	24			
		Gyraulus circumstriatus	24			
		Helisoma trivolvis	8			
Amphipoda	Hyalella	Hyalella azteca	660	8	CG	SW/SP
Basommatop	Physa_Physella	Physella acuta	336	8	CG	CN
Basommatop	Planorbidae	Gyraulus parvus	88	6	CG	CN
Coleoptera	Berosus	Berosus	8	5	PH	"CM(la), DI,SW(ad)"
Coleoptera	Coptotomus	Coptotomus longulus	4	5	PR	"CM (la), DI, SW (ad)"
Coleoptera	Dubiraphia	Dubiraphia vittata	60	6	SC/CG	"CN/50%, BU/50%"
Coleoptera	Haliplus	Haliplus	8	8	PH	CN,CM (la), SW,CM (ad
Coleoptera	Peltodytes	Peltodytes	4	8	PH	CN,CM (la), SW,CM (ad
Diptera	Chironominae	Chironomus	12	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Cryptochironomus	16	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Dicrotendipes	32	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Paratanytarsus	16	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Polypedilum	20	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Pseudochironomus	8	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Tanytarsus	72	7	CG/CF/PR	BU/CN/SP
Diptera	Dolichopodidae	Dolichopodidae	4	4	PR	SP
Diptera	Hemerodromia	Hemerodromia	4	6	PR	SP
Diptera	Orthocladiinae	Psectrocladius	20		CG/SC	SP/BU
Diptera	Tabanidae	Chrysops	8	10	PR	SP
Diptera	Tanypodinae	Procladius	76		PR	SP/BU
Diptera	Tanypodinae	Radotanypus	8		PR	SP/BU
Ephemeropte	Caenis	Caenis latipennis	176	8	CG	"SP/75%, CM/90%"
Ephemeropte	Caenis	Caenis youngi	8	8	CG	"SP/75%, CM/90%"
Haplotaxida	Oligochaeta	Tubificidae	8	8	CG	BU
Hemiptera	Corixidae	Corixidae	140	9	PH/PR	SW
Non-Insect ta	Ostracoda	Ostracoda	28		unk	SW
Odonata	Aeshna	Aeshna palmata	32		PR	CM
Odonata	Coenagrionidae	Enallagma	48	7	PR	CM
Odonata	Libellulidae	Libellula forensis	8	9	PR	SP
Odonata	Libellulidae	Libellula pulchella	12	9	PR	SP
Odonata	Libellulidae	Sympetrum	4	9	PR	SP
Trichoptera	Limnephilus	Limnephilus	8	3	SH	CM/SP

Montana Bioassessment Report

Waterbody Name: Otter Creek Site ASJT for the Coal Tracts Study **Benthic Sample ID:** 18137

Station ID: OTTER_JTt2 **Rep. Num** 0

Reference Status: **STORET Activity ID:** OTTRJTM-MAC-R

Site Classification: **Collection Date:** 05/17/2013

Latitude: **Collection Method:** MAC-R-500

Longitude: **Total Number of Individuals in Sample:** 750

Sample Taxa List

Order:	*OTU name:*	*FinalID:*	*Individuals*	*Tol Val:*	*FFG:*	*Habit:*
		Arigomphus cornutus	4			
Amphipoda	Hyalella	Hyalella	80	8	CG	SW/SP
Basommatop	Physa_Physella	Physella acuta	40	8	CG	CN
Basommatop	Planorbidae	Gyraulus parvus	20	6	CG	CN
Coleoptera	Agabus	Agabus	4	5	PR	"CM(la), DI,SW(ad)"
Coleoptera	Dubiraphia	Dubiraphia vittata	88	6	SC/CG	"CN/50%, BU/50%"
Diptera	Ceratopogoninae	Bezzia	8	6	PR/CG	SP/BU/SW
Diptera	Chironominae	Chironomus	112	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Cladotanytarsus	4	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Cryptochironomus	24	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Dicrotendipes	32	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Glyptotendipes	52	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Microtendipes pedellus Gr.	20	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Polypedilum	4	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Tanytarsus	28	7	CG/CF/PR	BU/CN/SP
Diptera	Ephydridae	Ephydra	4	6	CG	BU
Diptera	Orthocladiinae	Cricotopus	10		CG/SC	SP/BU
Diptera	Orthocladiinae	Psectrocladius	24		CG/SC	SP/BU
Diptera	Simuliidae	Simulium	68	6	CF	CN
Diptera	Tanypodinae	Ablabesmyia	8		PR	SP/BU
Diptera	Tanypodinae	Procladius	8		PR	SP/BU
Diptera	Tanypodinae	Thienemannimyia Gr.	4		PR	SP/BU
Ephemeropte	Caenis	Caenis latipennis	4	8	CG	"SP/75%, CM/90%"
Ephemeropte	Callibaetis	Callibaetis	4	9	CG	"SW/10%, CN/90%"
Haplotaxida	Oligochaeta	Tubificidae	36	8	CG	BU
Hemiptera	Corixidae	Corixidae	12	9	PH/PR	SW
Non-Insect ta	Ostracoda	Ostracoda	12		unk	SW
Odonata	Aeshna	Aeshna palmata	4		PR	CM
Odonata	Coenagrionidae	Enallagma	8	7	PR	CM
Trichoptera	Cheumatopsyche	Cheumatopsyche	16	5	CF	CN
Trichoptera	Hydroptila	Hydroptila	4	6	PH	CN
Trichoptera	Limnephilus	Limnephilus	4	3	SH	CM/SP

Montana Bioassessment Report

Waterbody Name: Otter Creek Site ASJT for the Coal Tracts Study **Benthic Sample ID:** 18138

Station ID: OTTER_JTt2f **Rep. Num** 0

Reference Status: **STORET Activity ID:** OTRJTfM-MAC-R

Site Classification: **Collection Date:** 10/15/2013

Latitude: **Collection Method:** MAC-R-500

Longitude: **Total Number of Individuals in Sample:** 2012

Sample Taxa List

Order:	*OTU name:*	*FinalID:*	*Individuals*	*Tol Val:*	*FFG:*	*Habit:*
		callibaetus	16			
		Gyraulus circumstriatus	12			
		Pisidium castertanium	8			
Amphipoda	Hyalella	Hyalella azteca	60	8	CG	SW/SP
Basommatop	Physa_Physella	Physella acuta	80	8	CG	CN
Basommatop	Planorbidae	Gyraulus parvus	36	6	CG	CN
BASOMMAT	Planorbidae	HELISOMA ANCEPS	4	6	CG	CN
Coleoptera	Berosus	Berosus	4	5	PH	"CM(la), DI,SW(ad)"
COLEOPTE	DINEUTUS	DINEUTUS	4	4	PR	
Coleoptera	Dubiraphia	Dubiraphia vittata	192	6	SC/CG	"CN/50%, BU/50%"
Coleoptera	Haliplus	Haliplus	8	8	PH	:N,CM (la), SW,CM (ad
Diptera	Ceratopogoninae	Bezzia	4	6	PR/CG	SP/BU/SW
Diptera	Ceratopogoninae	Culicoides	4	6	PR/CG	SP/BU/SW
Diptera	Ceratopogoninae	Probezzia	8	6	PR/CG	SP/BU/SW
Diptera	Chironominae	Chironomus	184	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Cryptochironomus	20	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Dicrotendipes	24	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Glyptotendipes	152	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Microtendipes pedellus Gr.	8	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Polypedilum	16	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Tanytarsus	104	7	CG/CF/PR	BU/CN/SP
Diptera	Dasyheleinae	Dasyhelea	4		CG	BU/SW
Diptera	Orthocladiinae	Cricotopus	132		CG/SC	SP/BU
Diptera	Orthocladiinae	Cricotopus bicinctus	32		CG/SC	SP/BU
Diptera	Orthocladiinae	Psectrocladius	100		CG/SC	SP/BU
Diptera	Simuliidae	Simulium	80	6	CF	CN
Diptera	Tanypodinae	Ablabesmyia	8		PR	SP/BU
Diptera	Tanypodinae	Procladius	56		PR	SP/BU
Diptera	Tanypodinae	Radotanypus	8		PR	SP/BU
Ephemeropte	Caenis	Caenis latipennis	208	8	CG	"SP/75%, CM/90%"
Haplotaxida	Oligochaeta	Tubificidae	48	8	CG	BU
Hemiptera	Corixidae	Corixidae	312	9	PH/PR	SW
Megaloptera	Sialidae	Sialis velata	36	4	unk	"CN,CM,BU"
Odonata	Coenagrionidae	Enallagma	16	7	PR	CM
Trichoptera	Hydroptila	Hydroptila	8	6	PH	CN

Montana Bioassessment Report

Waterbody Name: Otter Creek Site ASJT for the Coal Tracts Study **Benthic Sample ID:** 18138

Station ID: OTTER_JTt2f **Rep. Num** 0

Reference Status: **STORET Activity ID:** OTRJTfM-MAC-R

Site Classification: **Collection Date:** 10/15/2013

Latitude: **Collection Method:** MAC-R-500

Longitude: **Total Number of Individuals in Sample:** 2012

Trichoptera	Limnephilus	Limnephilus	8	3	SH	CM/SP
Trichoptera	Polycentropus	Polycentropus	8	6	PR	CN

Montana Bioassessment Report

Waterbody Name: Otter Creek Site ASJT for the Coal Tracts Study **Benthic Sample ID:** 18139

Station ID: OTTER_JTt2s **Rep. Num** 0

Reference Status: **STORET Activity ID:** OTRJTsM-MAC-R

Site Classification: **Collection Date:** 07/17/2013

Latitude: **Collection Method:** MAC-R-500

Longitude: **Total Number of Individuals in Sample:** 2012

Sample Taxa List

Order:	*OTU name:*	*FinalID:*	*Individuals*	*Tol Val:*	*FFG:*	*Habit:*
		Gyraulus circumstriatus	8			
		Pisidium castertanium	4			
Amphipoda	Hyalella	Hyalella azteca	84	8	CG	SW/SP
Basommatop	Physa_Physella	Physella acuta	88	8	CG	CN
Basommatop	Planorbidae	Gyraulus parvus	8	6	CG	CN
Coleoptera	Berosus	Berosus	4	5	PH	"CM(la), DI,SW(ad)"
Coleoptera	Dubiraphia	Dubiraphia vittata	76	6	SC/CG	"CN/50%, BU/50%"
Coleoptera	Haliplus	Haliplus	4	8	PH	CN,CM (la), SW,CM (ad
Coleoptera	Microcylloepus	Microcylloepus pusillus	8	5	CG	"CN/50%, BU/50%"
Diptera	Ceratopogoninae	Bezzia	20	6	PR/CG	SP/BU/SW
Diptera	Ceratopogoninae	Culicoides	4	6	PR/CG	SP/BU/SW
Diptera	Ceratopogoninae	Probezzia	8	6	PR/CG	SP/BU/SW
Diptera	Chironominae	Chironomus	360	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Cryptochironomus	68	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Dicrotendipes	88	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Glyptotendipes	152	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Microtendipes pedellus Gr.	8	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Polypedilum	60	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Pseudochironomus	4	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Tanytarsus	48	7	CG/CF/PR	BU/CN/SP
Diptera	Dasyheleinae	Dasyhelea	4		CG	BU/SW
Diptera	Orthocladiinae	Cricotopus	20		CG/SC	SP/BU
Diptera	Orthocladiinae	Cricotopus bicinctus	40		CG/SC	SP/BU
Diptera	Orthocladiinae	Psectrocladius	20		CG/SC	SP/BU
Diptera	Simuliidae	Simulium	16	6	CF	CN
Diptera	Tanypodinae	Procladius	84		PR	SP/BU
Diptera	Tanypodinae	Thienemannimyia Gr.	20		PR	SP/BU
Ephemeropte	Caenis	Caenis latipennis	80	8	CG	"SP/75%, CM/90%"
Ephemeropte	Callibaetis	Callibaetis	20	9	CG	"SW/10%, CN/90%"
Haplotaxida	Oligochaeta	Tubificidae	32	8	CG	BU
Hemiptera	Corixidae	Corixidae	528	9	PH/PR	SW
Heterostroph	Valvata	Valvata humeralis	4	3	SC	CM
Odonata	Coenagrionidae	Enallagma	16	7	PR	CM
Trichoptera	Hydroptila	Hydroptila	20	6	PH	CN
Trichoptera	Limnephilus	Limnephilus	4	3	SH	CM/SP

Appendix C *. Stream Habitat and Water Quality Parameters measured for the Otter Creek sites visited in 2013. na = not visited or sampled during this visit, dry.*

2013	OTTER_23			OTTER_22			OTTER_16			OTTER_3m			OTTER_2			OTTER_JT			OTTER_1A		
	May	Jul	Oct	May	Jul	Oct	May	Jul	Oct	May	Jul	Oct	May	Jul	Oct	May	Jul	Oct	May	Jul	Oct
Water Temp ©	na	na	11.3	25.6	29.3	9.4	19.2	21.5	7.8	na	na	na	22.6	20.3	8.7	21.7	17.1	6.5	11.8	26.3	7
TDS (ppm)	na	na	>2,000	1840	1865	1155	1701	>2,000	1085	na	na	na	1842	>2,000	1099	1563	1469	1000	>2,000	>2,000	1278
Conductivity (µs/cm)	na	na	>4,000	3671	3733	2312	3410	>4,000	2173	na	na	na	3668	>4,000	2199	3126	2935	2000	>4,000	>4,000	2664
pH	na	na	8.4	8.5	8.4	8.7	8.3	8.5	8.6	na	na	na	8.35	8.6	8.7	8.2	8.4	8.5	8.05	8.5	8.03
PFC	FAR	FAR	FAR	PFC	PFC	PFC	PFC	PFC	PFC	NF	NF	NF	FAR	FAR	FAR	PFC	PFC	PFC	FARd	FARd	FARi
BLM HBI	16	16	16	19	21	20	19	23	21	12	12	12	17	17	18	20	22	20	15	12	17
Avg wetted width (m)	0.0	0.0	0.2	5.7	6.5	5.9	10.8	10.7	11.4	na	na	na	1.6	1.5	1.2	4.5	4.3	4.8	2.7	2.4	2.1
Avg Left CHD (cm)	0	0	2	34	42	39	77	70	78	na	na	na	25	30	25	32	27	55	30	29	32
Avg Center CHD (cm)	0	0	2	43	46	46	91	85	90	na	na	na	40	42	32	34	35	59	36	37	40
Avg Right CHD (cm)	0	0	2	30	35	32	78	65	75	na	na	na	25	25	20	26	26	48	24	30	27
% Fines in Reach	90	100	95	83	88	88	84	88	91	100	100	100	45	50	45	60	65	54	100	98	97
% Gravel Reach	5	0	3	7	8	6	6	7	7	0	0	0	40	35	40	36	28	34	0	1	2
% Cobble Reach	5	0	2	10	4	6	10	5	5	0	0	0	15	15	15	4	7	12	0	1	1
Livestock Use (CPI)	28	15	56	20	18	10	35	0	8	42	50	30	5	12	5	22	0	12	64	35	25
Avg. Riparian Shade	0	5	0	0	10	0	10	20	10	10	40	20	10	40	20	10	30	10	10	40	20